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R E P O R T   R E S U M E S

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THE FEASIBILITY OF A COOPERATIVELY OWNED MULTIPURPOSE, MULTICHANNEL, CLOSED-CIRCUIT TELEVISION SYSTEM FOR INSTRUCTION, MATERIALS DISTRIBUTION, AND ADMINISTRATIVE DATA HANDLING.

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A FEASIBILITY STUDY WAS CONDUCTED TO DESIGN AND EVALUATE A MULTIPURPOSE TELEVISION SYSTEM FOR (1) DIRECT INSTRUCTION, (2) TRANSMISSION OF INSTRUCTIONAL MATERIALS, AND (3) ADMINISTRATIVE REQUIREMENTS OF A GROUP OF NEIGHBORING PUBLIC SCHOOL DISTRICTS IN A LARGE URBAN-SUBURBAN AREA. THE STUDY INCLUDED A DETAILED INVESTIGATION OF EQUIPMENT. THE SYSTEM IS A RECORDING, STORAGE, TRANSMITTER, AND DISPLAY SYSTEM FOR INSTRUCTIONAL AND ADMINISTRATIVE MESSAGES. THE CURRICULAR POTENTIAL AND TEACHER TRAINING REQUISITES OF THE SYSTEM WERE DETAILED. (HB)

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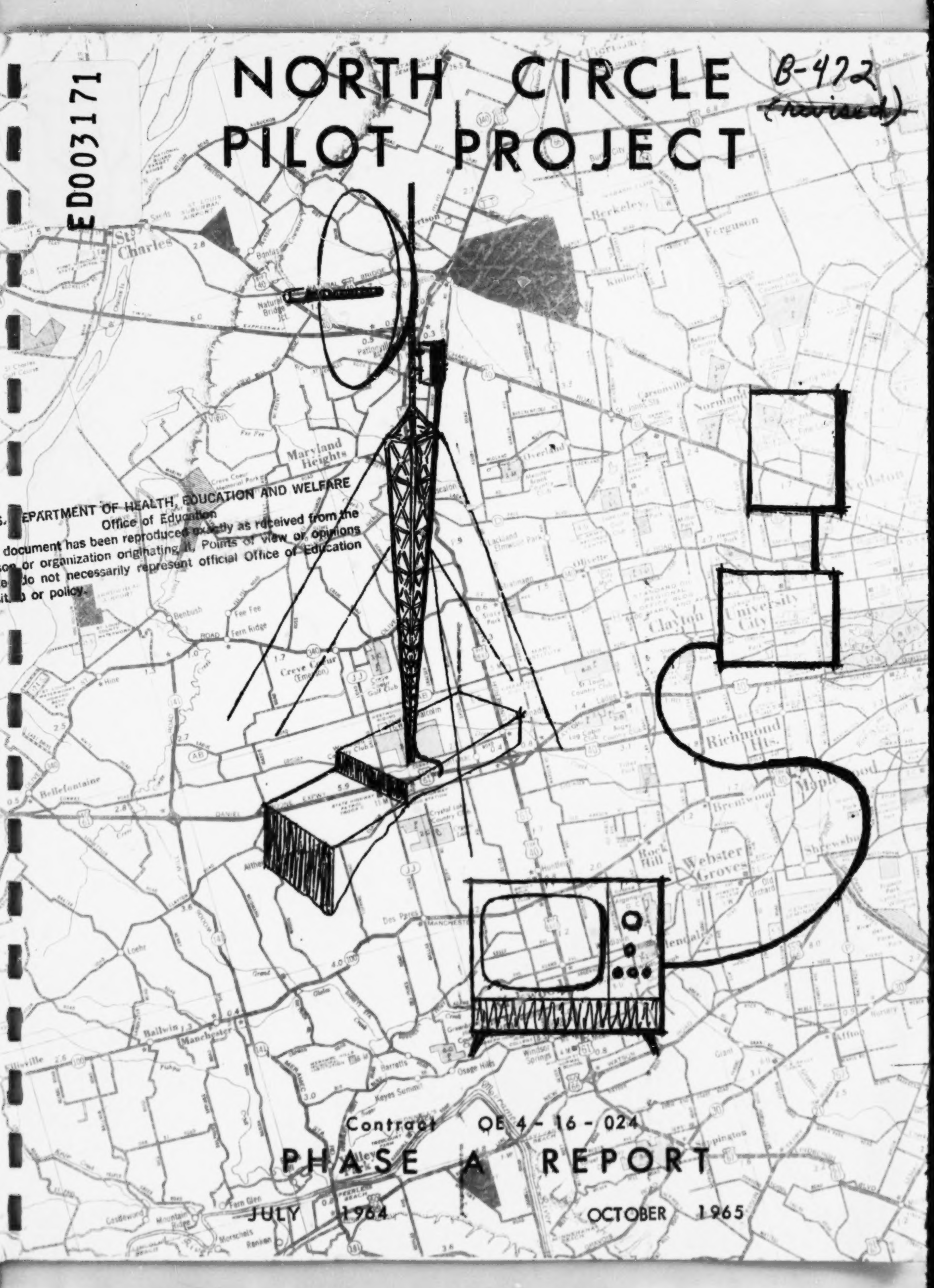
NORTH CIRCLE PILOT PROJECT

B-472 ~~(revised)~~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PHASE A REPORT

JULY 1964 OCTOBER 1965

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COOPERATING SCHOOLS A-V CORPORATION
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PREFACE

Establishing A Context

Few other pieces of equipment, in or out of the field of education, come in such a variety of price ranges, standards of quality, and degrees of complexity as do the components for television production, transmission and display. It is possible to buy a simple self-contained camera which plugs into a wall outlet and hooks onto the antenna leads of a regular television set. Although this is a picture-only system, it is a complete production-transmission-display system which can be bought for $500 or less. On the other end of the spectrum of price and complexity it is possible to buy highly sophisticated color cameras, high-resolution cameras capable of displaying very fine detail, special effects generators for ingenious mixing of pictures, elaborate switching equipment, videotape recording equipment....in short, commercial network gear. This latter grouping of television components can easily cost $50,000,000 for complete production-transmission-display facilities. Between these two extremes there lies an infinite combination of prices and equipment arrangements.

There are legitimate uses for the $500 system. Such a system can be utterly satisfying in its performance for enlarging small, but gross, visuals or keeping watch on a remote location.

Critics of the non-viewfinder, random scan, internally synchronized, single-lens surveillance camera system (the $500 system) are many. These critics have uses in mind for which the $500 system cannot qualify, nor was it designed to qualify.

The $50,000,000 super system with its endless list of electronic accessories is just as appropriate for complex dramatic programming or other intricate commercial and educational productions. There are also critics of this equipment level who insist that it is over-priced, over-engineered, over-staffed, and over-grown. These critics are undoubtedly thinking of lesser uses of television.

An obvious conclusion can be drawn: $50,000,000 is not too much to pay for television equipment if the system does a $50,000,000 job; and $500 is too much to pay for a system if the system doesn't do a $500 job. When appropriate use is made of appropriate equipment, efficiency results.

The very fact that a $500 system and a $50,000,000 system belong to the same generic family i.e. television, makes the discussion of a "television system" quite difficult. A television system "for whom"; a television system "for what"; and a television system "for when" . . . these must be defined if the reader and writer are to communicate.

The Context: For Whom?

The problems expressed in this report are those found in suburban St. Louis, Missouri. The solutions suggested in this report apply to suburban St. Louis. Application to another environ requires amendment to the extent that the other environ deviates from suburban St. Louis.

The Educational Field Services division of the Graduate School of Education of the University of Chicago recently surveyed, and in June 1962, published a very detailed profile of the community and the public school systems for which this television system is proposed. Comparison of other urban-suburban school district groupings would be facilitated by referring to this booklet. The report includes specific information from each of the 26 districts which comprise suburban St. Louis regarding:[1]

1. Valuation per pupil
2. Financial independence ratio
3. Expenditure per pupil (in ADA)
4. Average instructional salary
5. Average teacher training
6. Administrator/teacher ratio
7. Professional/non-professional personnel ratio
8. Average secondary class size
9. Average elementary class size
10. Program scope
11. Scope of services
12. Indices of socio-economic status

Updating some of the pertinent data found in the above mentioned report for the school year 1963-64 on a county-wide basis shows:

1. Valuation per enumerated pupil	$ 13,452.00
2. Average daily attendance	153,206
3. Number of teachers and administrators	6,789
4. Average expenditure per pupil	508.34
5. Hi-low range of expenditure per pupil	$296.11- $949.49

---

[1] Graduate School of Education, University of Chicago; School District Organization in St. Louis County, 1962, pg. 17 ff.

In addition to the educational and economic comparisons to be considered, it is necessary also that certain topographical factors and relative distances be compared. Any United States Geological Survey map of the St. Louis area, together with a similar map of other metropolitan areas interested in the plan, will provide the elevation and distance information required. A brief description of pertinent St. Louis geographical features follows:

Diameter encompassing the study area: 30 miles

Elevation extremes: 425 feet above sea level to 800 feet above sea level

Rapid changes in elevation: few, except in outlying areas

Man-made features: typical large office buildings, one large and several small airports, scattered industrial and other non-residential structures.

Climate and seasonal changes: less than 0° to more than 100°, in season; subject to hail, icing, heavy snow and severe winds. Temperate zone with full four seasons, high relative humidity; 35.31 inches average annual rainfall.

The foregoing, with detailed examination of the two references (study of St. Louis County schools and geological survey maps), tells "for whom" the proposed television system is suggested.

Although the resources of non-public school agencies are involved and opportunities for use by non-public school students are implied, this is a television system for public school use.

General Purpose of System: For What

The purpose of this study is to design and evaluate the feasibility of a multi-purpose television system for :

1. direct instruction,
2. transmitting instructional materials,
3. fulfilling administrative input-storage-retrieval requirements

of a group of neighboring public school districts in a large urban-suburban area.

All three segments of this multi-purpose system (instruction, materials distribution and administrative storage and retrieval) have seemingly endless requirements to be accommodated. The system proposed in this report attempts to meet these requirements as they exist. It is assumed that the nature and extent of current requirements will continue to change with time and new operating conditions. The system attempts flexibility and capacity to accommodate changes which have yet to be defined.

This is an investigation of the feasibility of an arrangement of hardware. It is a logistical system which is necessarily large in order to meet the variety and volume of demands to be made of it. It is a recorder, storage form, transmitter, and display system for instructional and administrative messages. The quality and content of the messages and the finesse with which they are used are supremely important points but, basically, this study is that of a communication form and not of message development. Minor exposition of the curricular potentials and teacher training requisites of the system will be detailed in this report. They are preliminary efforts to show what must be further investigated.

Timetable For Development: For When?

The long range view of instructional communication problems facing the Metropolitan St. Louis area shows that current operating procedures will not reach their goals. One by one, breakdowns of procedures are expected as each reaches predictable workloads for which it was designed.

Presuming that the television system described in this report is found to be feasible and desirable by the public school districts of Greater St. Louis or any other similar grouping of schools, the problem of sequencing and timing the steps from point A to point B requires prime consideration..

Point A might be considered the present posture and capacity for achieving those things to which this proposed system aspires. Point B would be the proposed system, fully operational, after all facets of the current practices are phased out. Leaving point A and arriving at point B in an orderly and efficient manner may be more difficult, by far, than defining point B and deciding to make the trip. At some stage, in phasing out A and implementing B, both A and B will be operational. The shorter this overlapping time period can be, the less will be the cost and confusion. It may be necessary to use interim procedures in such a transition, such as using kinescope recordings as a substitute for videotape recordings.

Such transitional procedures might be called point AB. This study, to date, has not included a thorough examination of point AB (the transitional operations). Only point A (current practices) and point B (proposed system) have come under scrutiny.

The following factors mitigate against early arrival at point B:

1. The lack of perfection of electronic gear to the degree and in the form needed by the proposed system.
2. The vast number of people who must re-orient their thinking and operations to permit the full implementation of the proposed system.
3. The lack of policies and administrative paths required to operate in the proposed fashion.
4. Sheer inertia.

Those factors which might speed up the process of radical and monumental change are:

1. Dramatic pricing changes and technical developments by industries who make component parts of the proposed television system.
2. Intensification of the problems facing public instruction which would require rapid change in order for public education to survive as an institution.
3. Internal or external forces which prompt public educators to review current problems and their alternate solutions.

Some hardware components have undergone recent changes. The changes have contributed greatly to the feasibility of the plan. For example, one of the essential components of the proposed system is a school-owned videotape recorder. Since this study began, videotape recording in schools has steadily become more and more feasible as industry has approached the requirements of a school-owned machine. Machines which once occupied 40 square feet of floor space are now joined by those requiring little more space on a desk than an audio tape recorder. Machines of great weight are now joined by those weighing less than 100 pounds. Machines costing $65,000 are now joined by those costing $3,000 and less. Time and technology seem to be on the side of the proponents of this study. If feasibility of the system outlined in this report depends on a highly reliable, very inexpensive, easily operated, maintenance free, high fidelity videotape recorder, it requires little daring to predict that such a machine is forthcoming.

Viewing those factors which mitigate against arriving at point B in the near future, and those factors which may speed up the process, an accurate prediction of the timetable for implementation of the proposed system would seem to be impossible. However, it seems that St. Louis County will fully implement point B in the next 25 years, considering the current pace of developments in and out of the field of education. The transition has actually begun.

St. Louis County public schools have already made, both consciously and unconsciously, many committments to this system.

To avoid a breach in communication later in this report, it should be remembered that the research staff is:

1. Aware of the great number of problems unsolved in its current studies.
2. Aware of the unpopularity of ideas and routines which disrupt or replace current thought and practice.
3. Aware of the need for new marketing relationships which must be established with suppliers of instructional materials.
4. Aware of the desirability of continuing current best practices until concrete proof of the efficiency of new practices is available.

The following sections review the nature of seven problems, and describe current methodology being used in metropolitan St. Louis public schools. It will be noted that all seven problems are universally found in public instruction, regardless of the size of the school system. In spite of this universality, methodology for working in these problem areas may vary greatly. The resources and other factors with which any given school system must work will determine what methodology that particular system can or must use.

Many educators THINK in the realm of the LOGICAL, but must WORK in the realm of the POSSIBLE. When the LOGICAL happens to be POSSIBLE educators can modify operating procedures to coincide with what they know should be done. The lag by education in accepting innovation and technology is a foregone conclusion.

Many people say education is 20 years behind the innovators, and, they imply that educators must be incompetents since they allow this lag to exist. As real as the criticism may be, the critics must surely realize that neither inertia nor stupidity is the cause for the status quo. Innovation, large or small, requires changing hardware, procedures, and the thinking of people. When the right hardware and the right procedures are understood and operated by the right people (those who truly understand, are trained to use, and agree with the use the hardware and procedures) the LOGICAL becomes POSSIBLE.

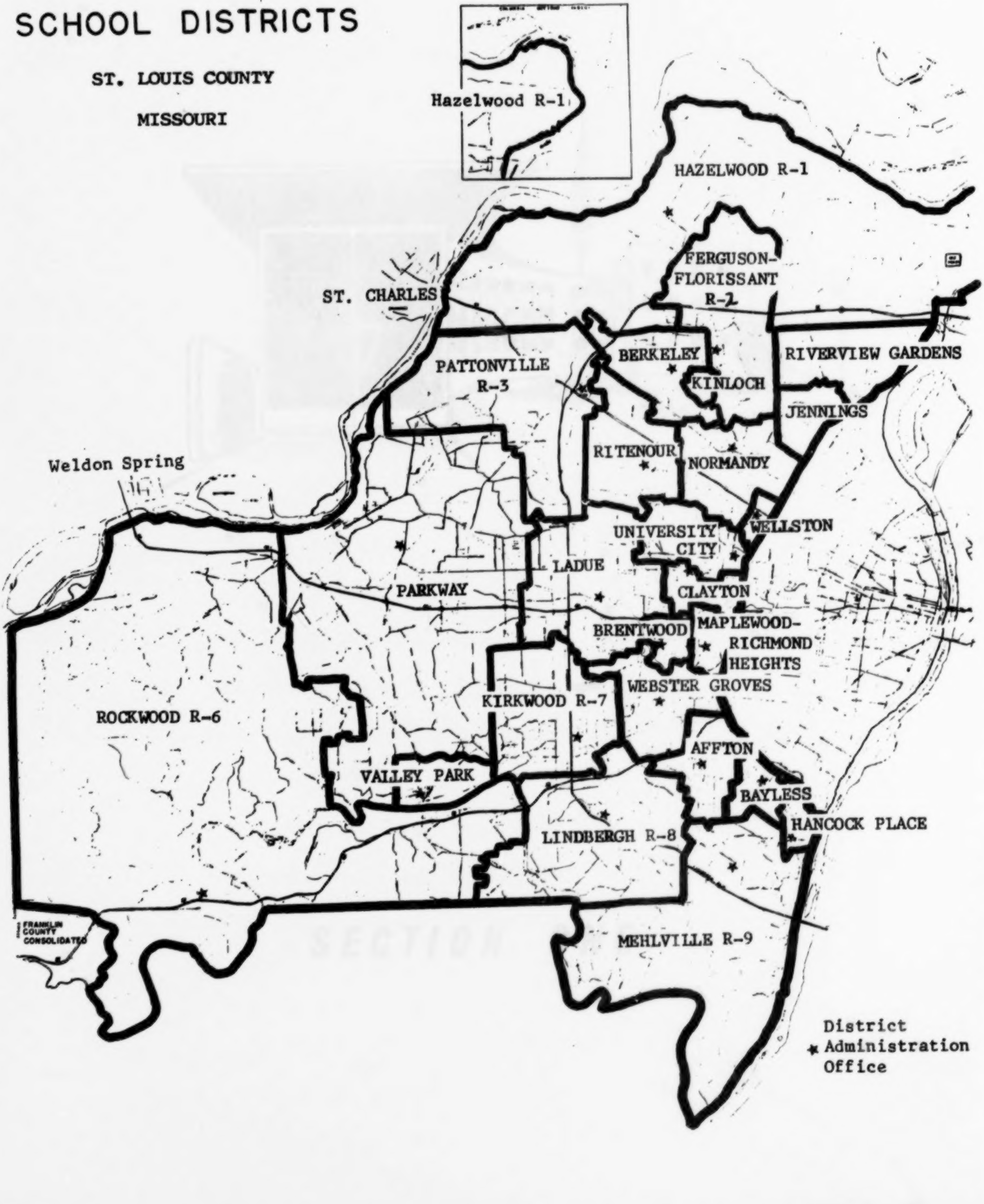
The smaller the innovation, the faster the implementation. Innovations which will affect the work lives of all students, all teachers, all supervisors, all administrators, all school boards, all taxpayers and all suppliers of materials, equipment and services will necessarily take time. How MUCH time will be determined by the speed with which pre-service and in-service education (concerning the innovation) takes place. Hardware can be obtained and procedures developed much faster than communication among people can be completed. It is, therefore, the problem of communicating to the to-be-involved-people, rather than any other reason, which causes the lag between innovation and implementation.

Phase A of this feasibility study is the first step in communicating the innovation being studied by the North Circle staff.

SCHOOL DISTRICTS

ST. LOUIS COUNTY

MISSOURI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HAZELWOOD R-1
FERGUSON-FLORISSANT R-2
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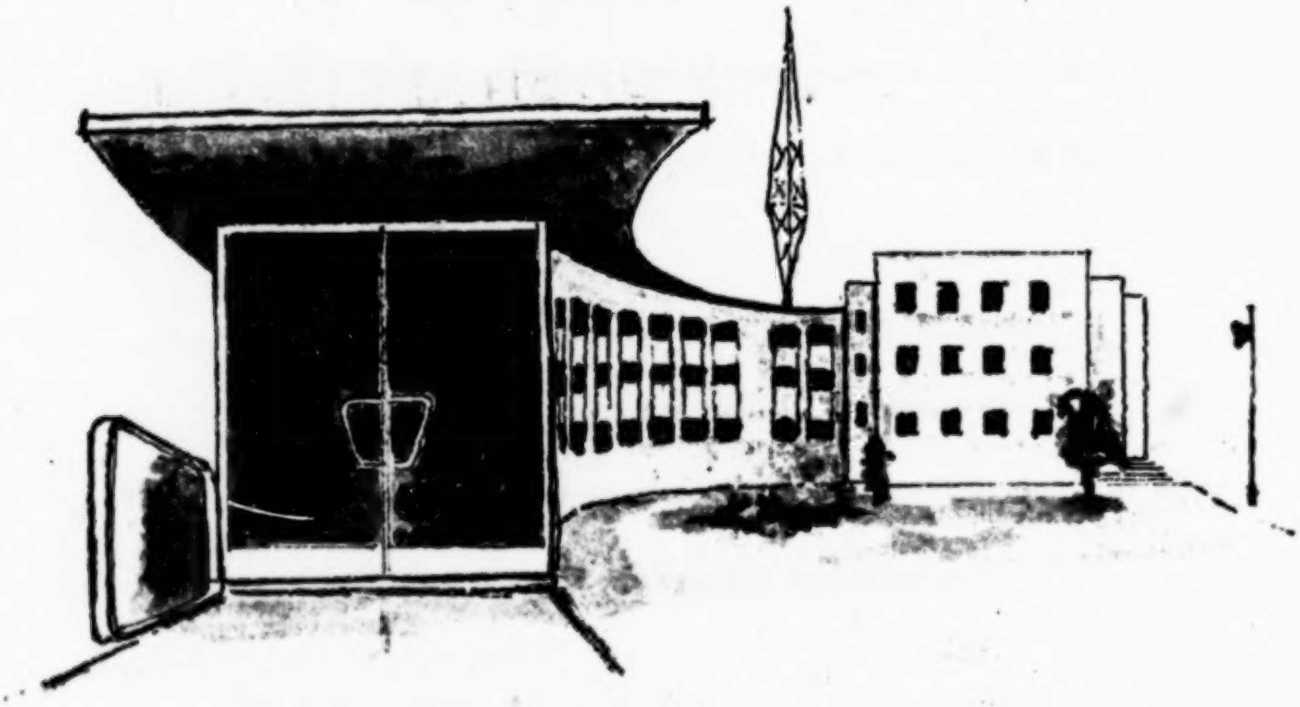
BERKELEY
RIVERVIEW GARDENS
PATTONVILLE R-3
KINLOCH
JENNINGS
RITENOUR
NORMANDY
Weldon Spring
UNIVERSITY CITY
WELLSTON
LADUE
PARKWAY
CLAYTON
BRENTWOOD
MAPLEWOOD-RICHMOND HEIGHTS
WEBSTER GROVES
KIRKWOOD R-7
ROCKWOOD R-6
AFFTON
VALLEY PARK
BAYLESS
HANCOCK PLACE
LINDBERGH R-8
FRANKLIN COUNTY CONSOLIDATED
MEHLVILLE R-9
★ District Administration Office



SECTION ONE

I. SOME BASIC AREAS OF CONCERN ARE:

1. Instructional pacing problems.
2. Staff utilization problem.
3. Problems of efficient use of open-circuit television.
4. Problems of storage and retrieval of instructional (audio visual) materials.
5. Problems in providing proper classroom facilities.
6. Problems in storing and retrieving administrative data.
7. Problems in storage and retrieval of materials found in other resource centers (libraries and museums).

The above listed concerns have two common denominators of importance to this study:

A. They are facets of public education in which the research staff of this project believe overwhelming problems exist and increase in the foreseeable future. They are likewise facets of the instructional process employing methodologies which are rapidly becoming obsolete.

B. They are problem areas for which electronic means of message storage and retrieval may be solutions. They might share a single, though complex, solution of the kind proposed and investigated in this study.

A further expansion of the seven basic concerns shows:

1. Instructional Pacing Problems: At one or more stages in the training of school teachers and administrators, each new

professional educator is inculcated with variations on the American public education theme: "Each child is an individual, having unique capabilities and needs unlike all other persons; public education hopes to accommodate each individual and assist him to develop to the fullest of his capacities." Yet curricular outlines, class schedules, inherent pacing within television, film and book productions, and many other factors relegate this laudable opinion to the category of lip-service educational philosophy. Most instructional materials have built-in pacing and direction which are not necessarily those of any specific learner. Even programed instruction devices (the closest educators have yet come to meeting students on their own terms) have built in directions by which the programer anticipates the students' thoughts.

Direct confrontation between student and teacher, and the resulting opportunity for interchange on the student's terms, in regard to readiness, means little if external forces continue to reduce control by the student or teacher over the learning-teaching act.

Current patterns requiring coordination between classroom teachers' activities and activities of "outside" agencies tend to diminish teachers' control over the appropriate timing of the presentation of experiences to individual students. The logistical and administrative problems involved in introducing educational television, film library services, special teachers, and other "outside" resources requires, more and more, that classroom teachers take the timing, pacing and content dictated by these "outsiders" rather than when the readiness of students for such experiences dictates.

The introduction of most innovations in education continue this trend of diminishing teacher control over the selection and pacing of student experiences. The result seems to be that the one person who has direct contact (and, therefore, ability to judge readiness) is being excluded from making such judgments.

The following quotation by Sir Harry Pilkington, head of the Committee on British Broadcasting, is pertinent to the discussion of external control of pacing and selection of experiences. In his report to Parliament in June 1962, he stated:

> "A service which caters only for majorities can never satisfy all the needs of the public . . .
>
> "No one can say he is giving the public what it wants unless the public knows the whole range of possibilities which television can offer and, from this range, chooses what it wants to see. For a choice is only free if the field of choice is not unnecessarily restricted. . .
>
> ". . .'to give the public what it wants' is a misleading phrase, because it appears to appeal to democratic principle, but does not. In fact, the slogan is 'patronizing and arrogant,' in that it claims to know what the public is, but defines it as no more than the mass audience. If there is a sense in which the phrase may be used it is this: '. . .what the public wants and what it has the right to get is the freedom to choose from the widest possible range of program matter. Anything less is deprivation."

The extreme individuality each of us possesses is admired, discussed and ignored. This individuality must be accommodated if any learner is to know his fullest capacity or approach use of it.

2. Staff Utilization Problems: Whereas, in most other professions and skilled jobs technological developments are employed to increase the productivity of the available work force, public education continues unnecessary wasteful deployment of its most valuable asset i.e., its staff. The most apparent examples of waste could be categorized as:

2.1 Duplication and Repetition of Basically Identical Presentations: Within each class period of each subject taught at each grade level there are countless lectures and demonstrations. Even during those class periods having a preponderance of time spent in interaction between students and teachers (discussion periods) there are some showing-and-telling segments presented by the teacher. Each such lecture or demonstration within a class period is potentially wasteful. For waste occurs if other teachers give basically identical lectures and demonstrations on the same topic down the hall or in other schools. The waste also occurs if any given teacher repeats the lecture or demonstration later in the day (for another class section) or later in the year or years for future students.

The waste of duplication and repetition and the drain on human resources and specialized facilities can be seen in the following illustration:

St. Louis County recently entered a new era of vocational and technical education. In June, 1965, the voters gave overwhelming support to a county-wide program which culminates the vigorous efforts of our county's educators, lay citizenry and legislative representatives. Heretofore, a grossly inadequate facility presumed to fill the needs of the non-college bound students of the County. The staff, students, and administrators of the former vocational-technical program were unanimously aware of its shortcomings. Better things now lay in store:

> . . .a solid tax base and bonding capacity replaces the tenuous cooperative support and student tuition finance system. The school is now eligible for the federal dollars being poured into vocational and technical education.
>
> . . .a three-campus system is envisioned for the County. These well-placed locations will replace the too-far-north school of the past. (Students spent a half day in their regular high schools for academic work and traversed cross county for a half day of specialized courses).
>
> . . .The new system has the assurance of continuity through its official status and will accommodate thousands of students rather than the two to four hundred enrollments of the past. The quasi-district (a cooperative of 26 school districts) gave varying support to the vocational-technical school according to the importance member districts gave to technical education and according to their distance from the old school.

All looks well for the future of vocational and technical education in St. Louis County. Here is a projected school system unencumbered with tradition and carrying forward few facilites. It hopes to have a three campus system to prevent transporting students over inadequate street systems to distant schools. Yet, the possibility of triplicating staffs and expensive apparati of instruction looms large. If the new school has data processing, printing, machine tool operation, and electronics as a four point program. It will require three computer setups, three print shops, three machine shops, three electronics labs, and three staffs. Otherwise, students in the south would have to travel to the "printing campus" in the north while students in the north would travel to the "electronics campus" in the south, if each campus were to avoid repetition of equipment and teachers. Considering the expense of equipment in these technical subjects and the rarity of outstanding teachers in the subjects, the triplication is an expensive answer to providing local instruction. It is predictable that changes in equipment will be called for as presses, computers and electronic trainers become obsolete (three changes in fact). No other area of instruction so dramatically emphasizes the cost of duplicating presentations or repeating presentations as does vocational-technical education. No other area has so much show-and-tell (versus discussion and student operation) which might be videorecorded or distributed by closed-circuit television to the two non-equipped campuses. How much reduction in cost or sharing of staff is possible by use of electronic interconnection of campuses can only be known through careful study. It seems patently wasteful to think of triplicating equipment and staffs in the future schools without seeing if each hasn't some prospect of serving multi-campuses with their reserve capacities.

Other non-specialized public schools should also be aware that similar waste occurs every day that a rare teacher is not extended to more than a few students or expensive equipment is used only a fraction of the potential capacity of the equipment.

2.2 Inefficient Deployment of Specialized Personnel: The visiting teacher concept for reading, art, music, language or other specialized programs is limited because face to face instruction is confined to the time specialists have. However, the number to be taught increases almost without limitation.

3. Open-Circuit Instructional Television Problems: St. Louis has one of the nation's oldest educational television stations in KETC, Channel 9. Having longer experience in the medium of instructional television than users of most open-circuit installations, educators in the St. Louis area are among the first to realize that:

3.1 The disparity is too great between actual and potential audiences for ETV;

3.2 The limitations of spectrum space make continued use of open-circuit television impractical as a basic instructional tool;

3.3 A community wide TV schedule and curriculum is usually nobody's schedule and curriculum.

3.4 The high cost of commercialized TV production precludes large volume teaching via TV;

3.5 Rigid work rules and procedures have been so highly developed in open-circuit television that innovation and useful progress in developing the medium is severely limited.

Excerpts from two papers are presented in the Appendix A of this report. The viewpoints expressed by Hungerford, Nissen and Knecht in these excerpts lend support to the staff's contention that open-circuit instructional television (use of VHF and UHF channels) is a deadend path in the search for new logistical patterns for teaching.

Cooperative programming, on an urban community scale, tends to conform more to the newly-developed traditions of educational television rather than the needs of specific students or specific teachers or specific curricular outlines of the clientele it serves. This is necessarily so because of open-circuit television's limitations in message-carrying capacity.

There have been many instances of open-circuit programming for the specific schedule, pace, curricular scope and sequence of a given school district in St. Louis. Telecourses in history, literature, modern algebra, and driver training are examples. Because of this specific accommodation of a single school district's requirements, satisfaction seems to have been consistently greater in these instances than in the general run of programming. However, turning open-circuit programming to focus on a single district's specificiations is not continuously or broadly possible. To do so, as a general policy, means the accommodation of 40 or more school districts in metropolitan St. Louis. No dispute is made here with the concept of open-circuit programming for minority audiences. Nor does the research staff believe unanimity in professional opinion of content is required for open-circuit programming. The point and the problem is:

Open-circuit instructional television lacks the message-carrying capacity to accommodate the clientele's specific needs. Those instances of greatest satisfaction with programming are frequently expressions by districts which have been suited by custom-programming. Other programming "for everybody" fails to show a significantly high actual-versus-potential audience rating.

Much of the value of instruction by open-circuit television is seen, by many, in its potential use rather than actual use. Those who explain away the inability of open-circuit television instruction to meet, or even approach, the original predictions for the medium usually cite the youth of open-circuit television in education. However, in few places in the myriad subfields of education does one meet such a body of research as in the field of instruction by television. And, seldom does one find rigid traditions so concretely set as in open-circuit educational television. "Infancy" is no legitimate excuse for open-circuit's failures. Can a defensible role be found for open-circuit instructional television which will be more satisfying than open-circuit television.

The following is excerpted from "A Statement" by Loren B. Stone, Manager, Station KCTS, University of Washington Seattle, Washington. This quotation, along with those in the appendix, illustrates the fact that the Project staff is not alone in its belief that cooperatively operated closed-circuit television facilities for instruction is the path to follow. All three quotations are by men who have close ties to open-circuit educational television. Because of this familiarity with open-circuit television, each has found the potential of closed-circuit television very compelling since all have commented on the vulnerability of open-circuit television as an instructional medium. The following position paper was presented at the December 7-8, 1964 Conference on the Long-Range Financing of Educational Television Stations.

> "Closed-circuit facilities will undoubtedly provide a satisfactory type of television service to most colleges, to many large individual schools (particularly secondary schools) and to some entire school districts in highly urbanized areas, where the distribution by open-circuit broadcast facilities will make this type of distribution essential for most public school instructional use...
>
> "In addition to the single broadcast service which will provide a basic instructional service to the schools and an evening educational and cultural program service to the homes, widespread use will be made by the schools of specialized low power transmitter facilities will provide the multi-channel service needed to make available a large number of simultaneous instructional programs to the schools.
>
> "Where closed-circuit distribution can be developed at costs which are commensurate with or competitive to the multi-channel low power broadcast facility, distribution will undoubtedly be by closed-circuit cable or microwave facilities rather than by broadcast.
>
> "Most individual school buildings will be equipped with multi-channel internal distribution systems which can distribute both the broadcast programs as they are received by a master antenna, and the specialized instruction which may be originated within the building itself either from live studios or from video-tape or film playback facilities. These locally operated, self-contained systems will permit television facilities to be employed in the larger schools for intensive help in meeting the needs of specialized instruction in science, music, mathematics, art and foreign languages. . .

> "There is great economic waste in the present development of instructional television for public school education, with almost every school group which is currently involved in television producing all of its own programming. Our schools do not each produce, separately, all their own text books, but utilize those that are produced and distributed nationally or regionally. The time must soon come when our schools can satisfy their needs for the instructional resources they use via television distribution facilities without each separate school having to duplicate what every other major system in the country is also doing. . ."

Without reference to costs or scheduling problems, it must be realized that the lack of message carrying capacity of open-circuit television is enough to cause educators to redirect their energies and funds toward multi-channel closed-circuit methods.

4. Problems of Storage and Retrieval of Instructional Materials: The point of diminishing returns has been reached in film library development. The elusive goal of having ". . .what a teacher needs at her school when she needs it" is not achievable under present operating circumstances. The following is excerpted from a paper presented by Paul Andereck at the NAEB-DAVI conference held at the University of Missouri 1964.

> "When most long range programs are begun, the process of growing and meeting daily problems becomes a full time occupation. The processes the beginner employs become goals in themselves. Processes become so intriguing that the doing becomes a sacred cow. Once the beginning is made, the REASON-FOR-DOING too often gets lost. We lose sight of our goals in a forest of daily operational crises. Here is an example which illustrates how the complex problems of operating can keep us so busy that we lose sight of our goals. In fact, this is the example which prompted the overall plan called the North Circle Project.
>
> "The Audio-Visual Department of the Suburban St. Louis Area is basically an instructional film library which is cooperatively owned by 26 school districts. The film library is 34 years old. It ships 92,000 films, 35,000 filmstrips and 6,000 tape recordings a

year. What's the goal we have in mind? Our goal, in part, is to have all filmed experiences which may assist teachers in teaching students. The other half of our goal is to have films IN THE HANDS OF THE TEACHER WHEN THEY ARE OF GREATEST INSTRUCTIONAL VALUE. Those of us charged with operating this film library are frustrated for several reasons in our attempts to reach these goals. Some of these reasons are: lack of funds, lack of productions in certain subject areas and the limitations of our distribution system. This latter problem is vital to the case being presented: limitations of our distribution system. We use trucks. Our department has visited member schools, weekly, for thirty-four years, by truck. Our trucks drop off films and pick up those left the week before. An ill driver, a broken down truck, schools closed because of bad weather, a dead battery . . . these are the daily crises which try the wits and tempers of a film librarian relying on trucks. Problems of this type keep him so busy he loses sight of his goals. Use of trucks creates three major problem areas:

1. Multiple print buying. If a film librarian buys one print of a new title and each booking ties up that print for a week, that new title can only be booked 38 times in a school year. Presuming that your clientele is composed of more than 38 teachers who might want that film, you must reject requests or you must buy more than one print of that title. This multiple print buying can be costly. A half-hour long film, in color, can easily cost $300 per print. Buy ten prints and you have $3,000 stuck in one title in your catalog. It is not uncommon for a library to buy 10, 20, or even 30 copies of a film in order to meet the demand.

My own film library has an average of 5 prints of every title. This ranges from 1 print of titles seldom called for to 32 prints of a highly seasonal film, such as "Autumn on the Farm". Even so, we have to reject 10% of all requests on the grounds that the prints we have are already booked by other teachers during the time period, the unfortunate late-order is desired.

2. Print replacement due to damage. Encyclopaedia Britannica Films, one of the largest instructional film producers, claims that a print will last an average of 10 years. This is largely due to the wear and tear a film receives in handling during shipment, during projection in the schools, and during the in-processing routine.

If this 10 year figure is correct, it means that you have to devote 1/10 of the value of your film library for replacement, each year. Our film library is insured for $1,000,000 and our annual budget for film purchasing is $100,000. As large as our budget for film purchasing is, it is a replacement-only budget. If we replaced 1/10 of our films each year our $100,000 would not be enough to buy the additional prints or new titles we need.

I have no doubt that Encyclopaedia Britannica's figures are correct. Some films last 30 years and others last 1 day in the hands of poor operators or faulty projectors. Of course, we DON'T spend a 1/10 of our budget on replacement . . . and our films show it. We have more splices in our films than I dare to count.

We have 3 inspectors working full time, with 4 expensive inspection machines, repairing damage which occurs . . . trying hard to extend the life of each print.

3. Time lag between ordering and receiving. It is the aspiration of every film library to have what the teacher wants in the hands of the teacher when she wants it. Most ordering systems, including my own, require as much advance notice as a teacher can give for each order. We ask that orders be placed two weeks prior to the delivery date requested. Of course, we respond much more quickly when we aren't given this advance notice. However, most teachers know that waiting too long to order is likely to earn them a rejection because others have already tied up the desired materials. Any teacher ordering "Winter on the Farm" after Thanksgiving hasn't a ghost of a chance of getting a booking all winter.

Experienced teachers avoid the last minute rush for films by ordering a semester in advance or even a year in advance. These teachers who try to predict, 8 months in advance the stage of learning their students will have reached, must be using crystal balls rather than course outlines. Yet, these teachers have used film service long enough to know the old "first come, first served" system.

The continued increases in operating costs and continued decrease in power to buy new materials will lead to lack of support of participating districts and jeopardy for the whole operation if a better way is not found, soon."

5. Problems in Providing Classroom Facilities

5.1 Attempts to physically house large numbers of students in special environments for instruction (science labs, home economics kitches, shops and the like) are costly drains on already short sources of building funds.

5.2 Innovations in building design which include folding walls, and other features to accommodate team teaching, will be successful to some degree in new school plants, but provide no solution for the hundreds of plants now in use.

5.3 *Making a classroom large* or small, at will, or converting lecture rooms into science laboratories, at will, cannot now be achieved without extravagant structural changes.

Two unique school designs in St. Louis County typify the architectural national trends, to provide the classroom space which can expand and contract almost at will. Berkeley Junior High School is a new building in which interior walls are movable in certain suites. Small groups, larger groups, and very large groups can be brought together according to the instructional unit-size desired. Though in attractive and functional execution of the movable wall concept, Berkeley Junior High School is not exclusive or unique. Many new buildings feature this expand-a-room reduce-a-room design. . . probably begun by the massive gymnasium door movement several years ago.

Valley Winds School in the Riverview District is an imaginative variation which follows the no-wall-at-all principle. Well placed furniture and acoustical treatment of floors, walls and ceilings provide the visual and auditory barrier between study groups in a very large open classroom suite. Moving the furniture provides the flexibility in size required. More and more of the Berkeley Junior High and Valley Winds types of buildings are being constructed across the country. But, what of the thousands upon thousands of schools built in the pre-flexible-class-space era? It is structurally impossible to modify most of the older buildings in order to accommodate this fairly new, and growing, space concept. Should the students in older buildings be deprived of the educational advantages which appear to be available to students in the newer buildings? Though true physical contact cannot be thus achieved, this research staff suggests that the same kind of togetherness-apartness may be brought electronically to older buildings, by the closed-circuit television system described later in this report.

The ability to bring a common resource to several study bodies at once is inherent in such a closed-circuit system. Moreover, the special apparatus found in another part of the building (or another building) could likewise be possible. In such case, it might be said that a "general" classroom could be converted to one with special equipment (though student contact is not possible) by bringing that equipment's visual aspects to the non-equipped rooms electronically.

In view of an ever-changing curriculum, the present method of equipping and re-equipping multiple rooms must seem a continuing frustration to administrators. Predicting the kind of environment, size of environment, and specialized facilities of our schools over the next 50 years (the life expectancy of most buildings) is impossible. Therefore, committing the unknown to concrete shapes is second-guessing destiny of the weakest sort. Room modification via electronics seems a worthy avenue of exploration.

6. Problems of Storing and Retrieving Administrative Data: Guidance personnel, financial accountants, supply personnel, administrators and supervisors will not be able to maintain files,

retrieve information, transmit a swelling body of information in areas of student, financial and supply accounting.

6.1 In regard to the problems of administrative data storage and retrieval, two illustrative situations, discovered during this study, serve to dramatize the new frustrations being experienced:

Several of the cooperating districts in the suburban St. Louis area use commercial data processing services of a large local corporation. Though they contract for grade reporting and class-scheduling work of like nature, each has a different data processing program used by the company. An employee of that corporation who processes these similar, but separate, jobs noted that the schools could save considerable money if a single program could be used regardless of which district wanted a grade recording and reporting job done. However, he dismissed the suggestion with the observation that as long as there were 27 different kinds of "F" being used by the various districts, a single economical program could not be employed.

The recognition by these districts of the efficacy of using automated processes for grade reporting is laudable. It shows the forward look of school administrators. But, the full fruits seem yet untasted. It is likely that cooperative approaches and coordinated and compatible reporting systems WILL be forthcoming. In such an event, collective ownership of a data processing plant by these districts is the next logical step. (The technical high school in St. Louis County has such a plant. However, the intense use of this machinery for training purposes may prevent extensive use as a school accounting machine-system.)

The foregoing illustrates that even those who use modern data processing techniques, in a limited way, continue to have difficulties. A case in point is the district which had, on its own, a complete processing plant for a short time. This district gave up these self-owned pieces of machinery after a short time and now contracts with the afore-mentioned corporation for data processing services.

The other illustration regards the technology of miniaturized storage form in student record keeping. One of St. Louis County's school administrators is responsible for keeping the student records accumulated during the district's entire history. Although these records were once housed in a high school vault, they now billow over into adjacent offices in file cabinets. The ever-present danger of losing these records through fire or vandalism is a constant worry to this administrator. After a study of this question and alternate solutions to this storage problem, this administrator concluded that the machinery, materials and labor required to convert these records to microfilm (which would require little space in that burdened vault) would be approximately $4,000. He also noted that expanding the vault to accommodate records now extant and those of the foreseeable future would cost approximately $36,000. His recommendation to his superiors was the obvious: "Go microfilm". Instead, it seems likely that the vault will be expanded. Should this impractical solution be chosen, it is likely that the technology of microfilming was unfamiliar and therefore undesirable to the decision-makers; vaults were not.

It is becoming apparent that new technologies may hold answers to administrative and instructional problems with which older procedures can no longer cope.

The community, school board, superintendent, and ALL school-related people may, for the first time, have to employ processes and machinery which they do not and cannot understand. If problems are to be solved by data processing machinery, microfilm methods, closed-circuit television or any other inherently complex technology, we may all find ourselves devoting unwarranted time to the study of these new technologies. . . or, relying on the recommendations of respected professionals to which we delegate the responsibility of understanding and operating these new processes.

Involvement in governmental projects, ever-increasing expansion of school services, and the steady increase in student population will compound the present problems related to administrative handling of information and records in our schools. Tentative adventures in data processing and expanding vaults are likely to provide no satisfying solution to these problems.

7. Problems of Storing and Retrieving Materials Found in Resource Centers: Museums and libraries are not geared for handling search, retrieval, and distribution of materials they house in a manner which will accommodate the ravenous appetites of learners.

The nature and extent of the "library problem" was well expressed in the September 3, 1965 issue of TIME magazine. Although it deals extensively with the problems of university and specialized libraries, it has obvious relativity to the school and public library problems about which this research staff is concerned. The article is reprinted herewith for its exposition of the problem. The reference to electronic means of storage, retrieval, transmission, and display suggests the same solution to which this research staff subscribes. The TIME article shows that other professionals are way ahead of the North Circle's staff in its thinking, and doing, in some areas. This is to the relief of the Project staff, since the solutions suggested in this research project are so many and so complex. Here is TIME'S perusal of the "library problem":

"LIBRARIES"

How Not to Waste Knowledge

The library that is most familiar to people is a hushed, well-stacked place, commanded--at least in fable--by a hushed, not-very-well-stacked spinster with her hair in a bun and ice in her eyes, and frequented by those who want to browse or drowse, study or doodle, read or simply exchange furtive notes with member of the opposite sex. There are still hundreds of such cozy havens all over the U. S., but they are turning into anachronisms. Their problem is that a technological age demands far more from a library than a quiet place to read and a random assortment of books.

Casual users of libraries are hardly aware of it, but library professionals and their more conscientious clients know about it all too well. They call it the "information explosion," and it has precipitated an odd paradox: most of the nation's public libraries have neither the money to buy nor the space to house the books and periodicals that a growing and insatiable public wants to read, while the technical disciplines--chiefly the sciences--have turned loose such a Niagara of information that even the wealthiest of corporate, collegiate or community libraries simply do not know what to do with it, let alone how to make it available to researchers.

"National Disgrace". Both the information explosion and the population explosion have forced libraries of all kinds to expand and to build anew at a spectacular rate, often with striking esthetic effect

U. S. colleges alone more than doubled their annual library-building outlay, from $21 million to $58 million, between 1957 and 1962, and spent a total of $211 million. In the succeeding six-year period, from 1963 through 1968, they will have tripled that amount to $650 million. The nation's largest library, the Library of Congress, has just renovated its main reading room at a cost of $309,215.

Still, the nation's public libraries are in bad shape. The American Library Association, which sets a minimum standard of 10,000 library volumes for communities with fewer than 2,500 people, figures that 69% of the 7,260 public libraries in the U. S. are substandard. Of the 8,000 elementary schools in the country, fully 60% have no central libraries, a state of affairs that U. S. Education Commissioner Francis Keppel calls "a national disgrace."

And, despite all the expansion, Allan Cartter, vice president of the American Council on Education, reckons that only 17% of the nation's college libraries meet the 100,000-volume standard that is considered minimum for good under-graduate instruction. Only 25 graduate schools, moreover, can boast the 1.5 million volumes considered minimal by the council. In all, says Cartter, only two dozen academic libraries are "really adequate." Among the best: Harvard's libraries (7,245,000 volumes), Illinois (3,748,000) the University of California at Berkeley (2,956,000), Cornell (2,577,000), Stanford (2,416,000), and U.C.L.A. (2,007,000).

Those schools, however, are exceptions. As Cartter says, there is a close correlation between the size of a library and the quality of a university. Thus most U.S. colleges are severly handicapped by inadequate libraries, since, among other factors, it is the quality of the library that attracts good faculty members and graduate students.

Acres of Cards. Unless even the best schools find ways of keeping current with new information, they too will run into incalculable trouble. Last year alone, 20,542 new books and 7,909 new editions of older books were published in the U.S.--nearly twice the number that came out in 1960. In addition, 22,262 periodicals and 80,000 technical reports rained off the presses. In many cases, it would have been merciful to save good paper. At the same time, there is no question that a lot of worthy material will go wasted and unread.

Yet who knows what is being missed? About 90% of all scientists who ever lived are now at work--and, it seems, most are publishing their findings. In 1750, there were about ten scientific journals in the world; today there are about 7,000 related to the biomedical sciences alone. Once scientists wrote about physics, chemistry and biology; today they deal with the likes of bio-chemistry, bio-engineering, exobiology and biophysics. In 1950, chemists produced 558 articles every two weeks for their publications; in 1965, in the field of chemistry alone, those learned explorers are turning out--and publishing--6,700 articles every fortnight. Small wonder that the U.S. Printing Office is drawing up plans for a new building with 40 acres of working space--six acres bigger than the Pentagon; or that Yale, if it were to continue using its obsolescent card catalogue, would need eight acres of floor space by the year 2040 just for the cards alone. The books would be virtually unhousable.

Skating in the Stacks. For specialized libraries in particular, the only answer to suffocation by paper is automation, which runs from the crudest idea to the most dazzling concept of the sophisticated mind. In the Detroit Public Library, book procurement is speeded up by sending boys whizzing down the 250-ft.-long stacks on roller skates. On the other hand, scientists dream that one day a scholar will be able to quiz a regional computer by telephone from his office; whereupon the answer, perhaps from a paper by a foreign colleague, will bounce off an orbiting communications satellite first into a simultaneous translator and then on to the scholar's TV screen.

Between these two extremes, much has already been achieved. Dozens of libraries are using data-processing machines to record book purchases, to keep track of the books that are lent, and even to grind out overdue notices. But that kind of automation mainly helps the librarian. More significant automation is aimed at helping the reader and researcher discover precisely what information is available. Uncounted millions of dollars are wasted annually by scientists repeating research that someone else has already painstakingly carried out and published. An odd medical fact tucked away in a periodical might save a life if the right doctor only knew that it was there. So far, however, only a fourth of the nations's available scientific literature is now catalogued. Many physicists are aware, for example, that one of the most complete collections of Chinese physics periodicals rests in an Air Force research laboratory at Massachusetts' Hanscom Field, but due to the lack of an adequate cataloguing system, none really know what is in it.

Apart from the problem of translation, the technology of bibliographic control in scientific fields is already a reality. A leader in the field is the National Library of Health in Bethesda, Md., which tries to acquire every publication relating to medicine. Librarians feed selected references from articles in 2,400 periodicals into two Honeywell computers. Then, by the use of key words, the computers each year arrange 150,000 citations alphabetically. This list is printed by a computer-driven phototypewetter, and the result is a book, the Index Medicus, which goes to 7,000 libraries around the world. A researcher in London, for example, can leaf through the Index, find the citation he wants, and request it of his local librarian, or, if necessary, seek a copy from Bethesda. Chemists benefit from a similar service in Columbus, Ohio, where articles on their specialty are abstracted and indexed by computer; the "express-indexes" are sold by subscription.

Bookless Colleges. The next step after bibliographical control is retrieval of information itself. Computers cannot yet actually "read" documents and pull out the relevant parts. They can, however, select copies of entire documents. The most advanced example of this technique is the CIA's "Walnut" system, by which an 8-in. by 14-in. page of information is reduced to a microscopic image; any one of 990,000 images can be plucked out of the CIA's computers within five seconds, after which it can either be projected on a screen or reproduced on paper.

Academic libraries are laying plans to tie themselves together electronically so that each can benefit from the resources of the others. The medical libraries of Harvard, Yale and Columbia have been preparing punch cards for three years for such a network. Another system is Project Intercom, shard by a steadily growing number of colleges (now ten), which hope to unite their literature through computers, beginning with the medical and biological sciences. Eventually, says Intercom Executive Director Dr. James Miller of the University of Michigan, there will be a network of bookless libraries--study booths, electric typewriters and TV screens--in which "a small college will be able to have a better library than Harvard has now."

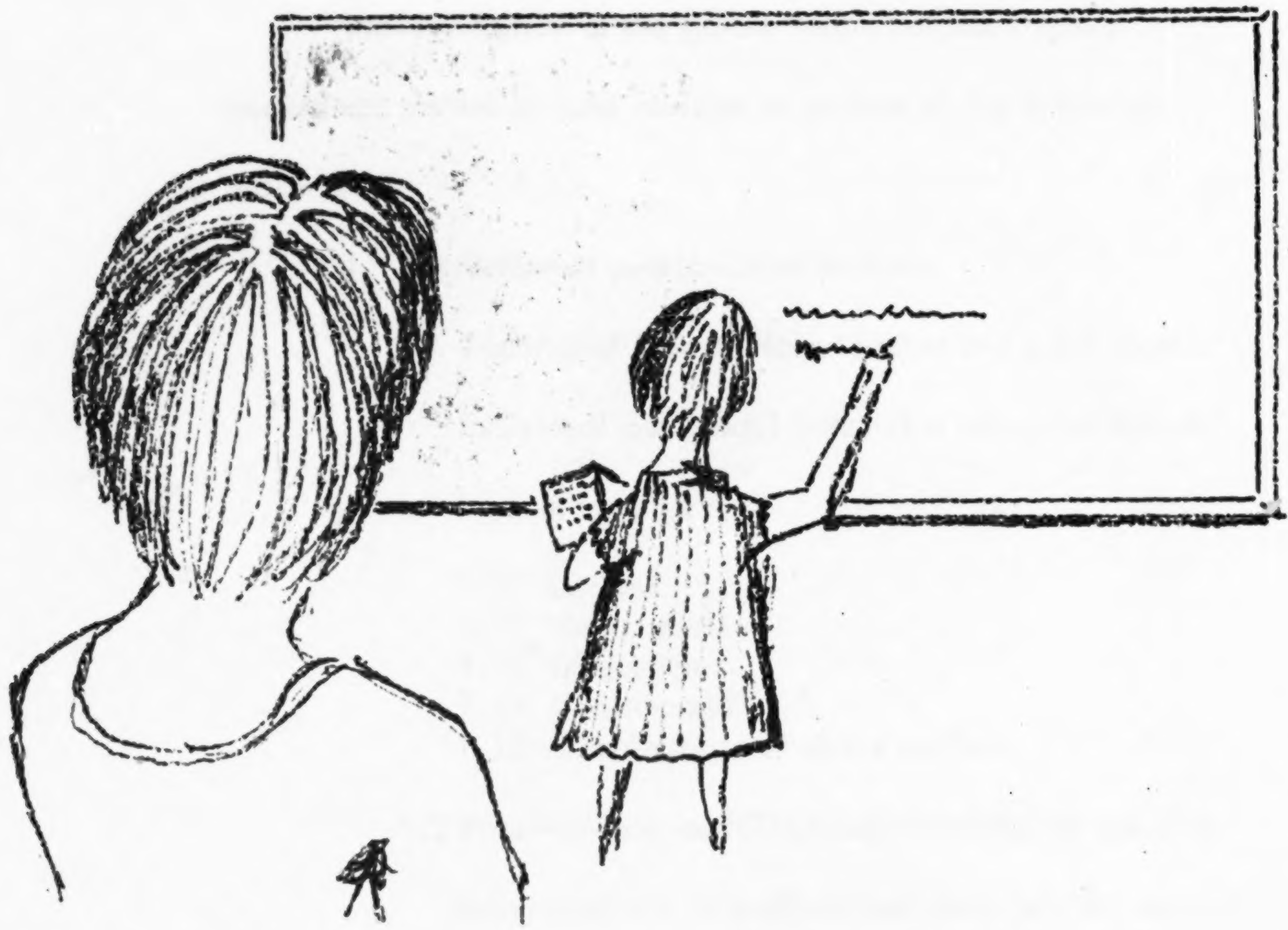
Blow to Browsers. The real key to that kind of progress is automation of the recently facelifted Library of Congress, which tries to catalogue every publication in the U.S., now has 40 million 3-by-5 cards in its files. Converting that catalogue to tapes for computer use would cost about $40 million--but a librarian anywhere in in the U.S. would then have a constantly updated index to all U.S. publications. The Library of Congress could use a Data-Phone system to flash information by ordinary telephone line to any library that requests it. The system, already employed for high-speed communications, uses perforated tape that transmits signals to remote printing machines at the rate of 6,000 words per minute--all for the price of a long-distance telephone call.

The only fear is that large-scale mechanization of libraries may dampen the joy of the ordinary reader, who simply likes to mull through the library shelves. And it could be a big blow to serendipity in the stacks: gone will be the excitement of discovering the right answer in an unexpected place. On the other hand, automation will put a higher premium on the professional ability of librarians, who will have to organize knowledge far more precisely than the Dewey Decimal

System demands. "All the money in the world isn't going to get a computer to judge what is worth storing and what is not." says the University of Pennsylvania Assistant Director Jesse Mills. Amid the proliferation of paper, that kind of judgment will continue to be far more valuable than any technical breakthroughs.

The foregoing illustrates a list of the salient problems for which a multi-purpose communications system is needed. Even today, single purpose procedures employed for communicating certain phases of instructional or administrative information are highly sophisticated in Metropolitan St. Louis. The cooperative movement toward sharing common responsibilities has reached a high degree of the art. Among the more concrete joint-ventures of this metropolitan area are the Audio Visual Department, Technical-Vocational school and educational television ventures.

It is the judgment of many competent authorities (see Appendix I) that a unified, comprehensive, compatible cooperatively-owned and operated communications system can be devised and employed for the solution of many major problems facing an urban-suburban area.



SECTION TWO

SECTION II

CURRENT METHODOLOGY BEING EMPLOYED BY GREATER ST. LOUIS PUBLIC SCHOOLS FOR OPERATING IN THE AREAS DETAILED IN THE PRECEDING LIST OF PROBLEMS

Implementation of the system herein proposed would necessitate partial or total revision of certain of the following procedures:

1. Instruction of public school students:

1.1 Traditional face-to-face teacher and pupil (both individual and group) instruction using the following methods:

1.11 Lecture
1.12 Demonstration
1.13 Discussion
1.14 Coach-pupil
1.15 Combinations of above methods

1.2 Face-to-face instruction supplemented by use of a broad spectrum of audio-visual materials and associated machinery:

1.21 Texts
1.22 Maps and charts
1.23 Models
1.24 Projected materials
1.25 Auditory materials
1.26 Training devices and auto-instructional materials
1.27 Broadcast materials
1.28 Realia
1.29 Study trips and resource persons

1.3 Experimental-operational innovations developed in relatively recent years:

1.31 Team-teaching
1.32 Open-circuit television assisted instruction
1.33 "Modern" methodology developed for specific subject areas

Though varied in form and supplemented by some recorded materials, the current teaching methodology in St. Louis County is a "live" face-to-face confrontation between teachers and varying class sizes.

Scope, content and pacing are largely dictated by course outlines, chosen texts and other instructional materials.

2. Instruction by open-circuit television

   2.1 One-way lecture-demonstrations, pre-scheduled and repeated at several times for scheduling convenience.

   2.2 Most instruction is packaged as series or broad units, used in conjunction with classroom instruction (which carries the basic responsibility). Some series are presented as "total" or "direct" teaching and consists of daily presentations to which classroom or individual work is supplemental.

   2.3 Some programs or series are developed and scheduled to meet the requirements of a specific study body or school system. Others aim at a community of schools at large and are developed to meet requirements common to many districts.

   2.4 Largely pre-recorded and without "talkback" facilities, programming is expository and attempts to generate individual and group on-going activities or provoke interest in further investigation of the topic being covered.

2.5 Production facilities and programing techniques tend to follow successful practices of commercial television programing in public service, documentary, panel and other non-entertainment categories. Emphasis is placed on polish to an extent that technique and technical perfection sometimes compete with content and purpose for attention, effort and funds.

2.6 Professional artists and technicians are hired to meet requirements of the medium; non-paid educators are assembled to meet the requirements of the message.

2.7 One VHF channel is used between 8:00 a.m. and 3:30 p.m. to program for in-school use in grades K through 12 and in a scattering of subject areas. Schools are equipped for reception in varying degrees of completion. Generally, school equipment falls short of professional recommendations in quality and amount.

3. School-owned instructional film libraries:

3.1 Two school-owned instructional film libraries operate in the Greater St. Louis Area. Each has a specific clientele based on its ownership and funding source: the Division of Audio Visual Instruction of the St. Louis Public Schools serves the city school system of St. Louis; the Audio Visual Department of the Cooperating School Districts of the Suburban St. Louis Area serves 26 public school districts in St. Louis County and one district in St. Charles County (member districts who cooperatively operate the Instructional Materials Center).

3.2 Both film libraries have instructional materials other than motion pictures. The procedures in film library operation of both are basically the same:

3.21 Most films are purchased or leased. Few are locally produced.

3.22 All films are stored in their natural state. . . without conversion to another storage form.

3.23 Descriptions and listings (catalogs) take a book form and periodically revised catalogs are distributed to teachers of member districts.

3.24 Manual processes are employed for initiating and processing requests for future materials-delivery.

3.25 Shipment preparation is accomplished by loading containers for carrying the films.

3.2 Shipment to the using-teacher is accomplished by using panel trucks on regularly scheduled routes to member schools.

3.27 Materials are displayed to the learners by teacher (or student) operated projection equipment and screens.

3.28 Materials are returned after a standard use-period by the same trucks employed for delivery (at a later visit).

3.29 Films are in-processed by inspecting, rewinding, and shelving.

3.30 All administrative record keeping is achieved by manual recording and filing techniques.

3.3 Audio materials are handled differently by the two materials centers. The city schools employ an educationally licensed FM radio station for distribution,plus physical shipment of phonograph records by truck; the cooperating schools duplicate the content of a tape recording library onto teacher-submitted blank tapes. These tapes are sent to the center and returned by the film delivery trucks.

3.4 The city schools use a combination of central storage-shipment and school-housed techniques for supplying non-film, non-audio materials to member schools. Mounted specimen, realia, study prints and other kinds of materials are centrally stored and distributed in much the same manner as films.

The cooperating school districts do not distribute materials other than films, filmstrips and tape recordings from a central depository. Other materials are usually stored by academic departments in schools or in other local supply stations (from district level to classroom level).

4. Building facilities and instructional environment:

4.1 In Greater St. Louis. no one-room schools survive. However, many very old school buildings are still in use. New school construction represents a great range in architectural and academic thought (including campus arrangements, circular-shaped buildings, wall-less rooms, and other imaginative or argumentative designs).

4.2 Many of the newly-built schools incorporate one or more innovations for accomodating curricular changes and methodological changes foreseen or in practice:

- 4.21 Air conditioning
- 4.22 Large and flexible conduit systems
- 4.23 Movable classroom walls
- 4.24 Multi-purpose rooms
- 4.25 Highly specialized-use environments
- 4.26 Flexible expansion or modification features.

4.3 All districts find financial support for buildings and programs more difficult to obtain each year. Building designs often reflect a conflict between existing financial conditions and academic judgments. A resulting adequate-but-less-than-hoped-for plant is often found.

4.4 Conservatism and pragmatism dominates, with rare exception, in the actual execution of buildings which are intended for use in the next 50 to 75 years. Futuristic planning usually is limited to the visible requirements of today rather than the invisible demands to be placed on those buildings near the end of their life-use span.

5. School administrative routines:

5.1 A few very large, very wealthy or very progressive school districts employ data processing machinery of the computer family level for educational, financial, inventory, record keeping, or problem solving. In the instances where districts do employ automation, they do so by owning or renting use of equipment. Without cooperation with neighboring districts. Some uses are experimental and other uses are backed up by continuation of manual data processing. Excepting the city school district, no district has made a multi-use or irrevocable committment to large-scale data processing.

5.2 Miniaturization of records through microfilm technology or use of automatic information retrieval techniques is non-existent. People, paper, file cabinets and adding machines compose the basic tools for administrative data handling.

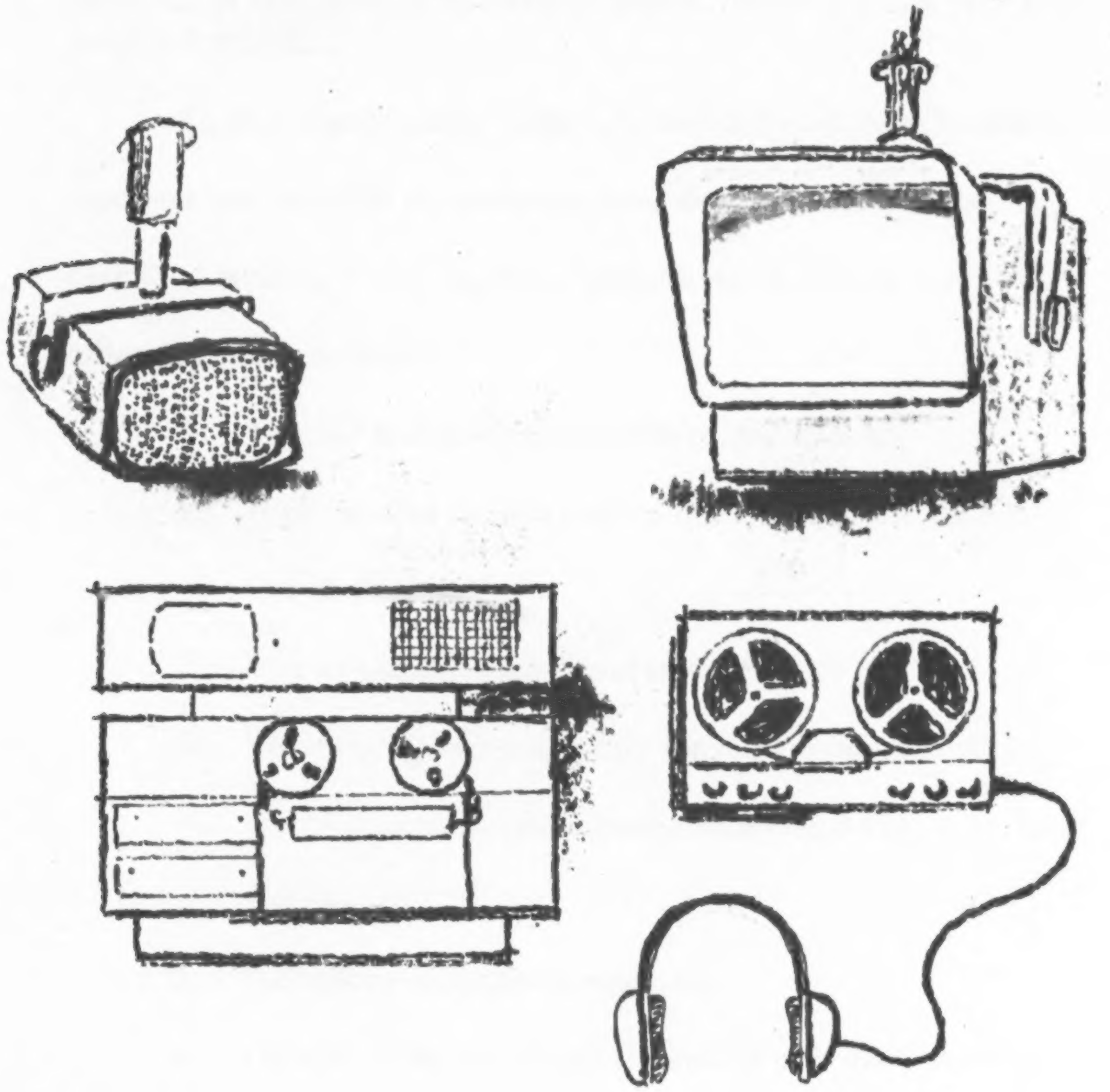
6. Community Resource (non-school owned) materials handling:

6.1 Museums and libraries of Greater St. Louis employ practices for storage and retrieval which were employed in the 19th century. Rare exceptions are found: the St. Louis University Pope Pius microfilm library is one.

6.2 Users must transport themselves to the depository to pickup or view-on-site the resource materials. Electrostatic and other means of on site copying of materials for later reference is recent and quite limited.

6.3 Competition for possessing the sole or few copies of materials which are loaned is increasing, rapidly.

6.4 The learner must adapt to administrative convenience more often than the resource center can adapt to learner needs.



SECTION THREE

SECTION III

CHARACTERISTICS A NEW LOGISTICAL PATTERN FOR INSTRUCTION, MATERIALS DISTRIBUTION AND ADMINISTRATIVE DATA HANDLING SHOULD POSSESS

To do a significantly better job than is being done by current processes and to avoid the problems inherent in current procedures described earlier, a new logistical pattern should possess the following characteristics:

1. Teacher and student acceptance and control.
2. High fidelity in both picture and sound at the learner's end of the line.
3. Ease of use by teacher and student.
4. Virtually infinite capacity for total message handling and high capacity for message handling during a 24 hour period.
5. Reliability of system components.
6. Flexibility for handling all kinds of pictorial, auditory or coded messages.
7. Ability to be easily extended to additional classrooms regardless of distance or location.
8. Relatively short time interval between ordering and receipt of instuctional materials.
9. Flexibility regarding location and type of input.

10. Ability to service non-school population for inquiries and retrieval of information.
11. Ability to be current and apace with curricular changes.
12. Ability to keep materials in good repair or near perfect condition.
13. Ability to eliminate or reduce multiple copy buying where possible and minimize replacement of materials due to damage.
14. Ability to transfer human manual operations to machine operations in every instance where greater efficiency can be gained.
15. Long range economies in terms of cost per message carried in each category: instruction, materials distribution and administrative data handling.
16. Efficient employment of "exotic" and expensive staff and hardware through cooperative use of both.
17. Versatility in output form to satisfy requirements for one-time or many-time use of delivered messages.

A further expansion of each of the above shows:

1. Teacher and student acceptance and control

Television in the open-circuit broadcast style (mimed by many closed-circuit systems observed by the research staff) not only presents information and experiences to assist the learner (and the classroom teacher working with the learner), but also presents a curriculum, a schedule, a pace, a personality (the TV series-teacher) and a scope and depth. Repeated conferences with teachers has revealed that these are not the curriculum, schedule, pace, scope and depth wanted by any given teacher. Furthermore, the personality (TV teacher) constitutes an uncomfortable competition with which only the most confident classroom teachers manage to live. These intruding directions of curriculum, schedule, pace, scope and depth (combined with the possible personality conflict) contribute a great deal to the non-use patterns in open-circuit instructional television, and to closed-circuit television which patterns itself on open-circuit formats and procedures.

The closed-circuit system described herein must be so programed as to allow use of information and experiences in each teacher's curricular context, desired schedule, locally determined pacing, and in the teacher-chosen scope and depth. If "singles" rather than "series" typify the bulk of messages transmitted, the competition between TV and classroom teachers does not exist. Certainly, each film or book or videotaped demonstration transmitted has built-in pace, depth, personality, etc., but, not so dominant or solidifying that the material is not useful in a classroom-directed context.

It is believed that the proposed system gives control to the teacher (or student in cases where students order and directly use materials) which assures an acceptance not enjoyed by other modern styles of television.

2. High fidelity in both picture and sound at the learner's end of the line.

Currently most open and closed-circuit instructional television is black and white American broadcast standard television (the exceptions being the rare color and high resolution systems used in non-public school instruction). The extent to which color is important seems irrelevant . There are many messages in which color is vital to understanding or appreciation. This fact requires that such messages must be transmitted by color circuits and color accepting machinery. Since color is not required for the understanding of the vast majority of messages, relatively few "trunk lines" and sending-receiving pieces of equipment need to be color television components. The requirements for color should be compared to the cost of color in determining how many of the multi-channels must be color.

Aside from color, the legibility of pictures depends on the "resolution" capability of all television components employed in a total system. "Resolution" can be expressed in lines per frame of television scanning and full discussion is unwarranted here. For now, consider resolution to be pictures what frequency response range is to sound. Naturally, the higher the resolution, the more legible or complete the picture detail; just as wider the frequency response range, the more complete the sound detail.

If a human voice, speaking in a relative monotone, is to be transmitted fully and faithfully, very little range of response is required in the microphone, amplifiers, transmitters, receivers or speakers employed in a radio or wired system of voice transmission. However, telephone conversations that are often "tinny", "hollow", or "low fidelity" result from the fact that one or more components in a telephone system has insufficient range of response to accept and pass on the range of human speech, much less the wider range of musical instruments. Even so, the message being carried over the phone is usually intelligible and sufficiently clear for complete understanding of voice-conveyed messages. So long as no one attempts to push a wider range of sound frequencies through ordinary telephone apparatus, satisfaction is given. He who attempts to play a violin over a phone will have to be satisfied with loss of much of the "message" as phone components "shave off" sound frequencies outside their capacity of response. The melody or "gross image" will probably survive the transmission but all the overtones and innuendos of sound will be lost.

There is a parallel between the above illustration of "low fidelity" sound transmission and black and white American broadcast standard television. Whereas the full scope of a sound-only message may require stereophonic and wide range frequency response components to completely pass all elements of the message

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(and there are needs for such "high fidelity" faithfulness in sound transmission-reproduction), television messages have far more message components. Complete and faithful transmission of messages involving pictures and sound may require stereophonic and wide range frequency response components AND components which will accept and pass on the tonal range, the color, the dimensions, the detail, the motions, the full list of visual ingredients of the original image. By the reader's leave, we will ignore the smells and textures of the image being transmitted.

American broadcast standard television is to pictures what standard telephone is to sounds. Further, American broadcast standard television is to "high resolution" television what telephone is to FM radio, expensive hi-fi equipment or any other form of "highest fidelity" sound message carrying system.

The National Association of Educational Broadcasters publication Standards of Television Transmission, published in June of 1964, is an eye-opening treatise on the subject of higher resolution television for instructional purposes.

As interpreted by this research staff, the basic theme of the book is:

A. The American Broadcast standard of television is not now (and never was) the only and best standard of resolution possible.

B. It was accepted as the standard for commercial telecasting (and copied by almost all other forms of television in the United States) simply because it was the best resolution which could be delivered at a price which permits the purchase of production, transmission and reception equipment on the broad scale now found in the United States.

C. A higher standard of picture fidelity (resolution) would have prohibited the use of television as a home entertainment-information medium.

D. The requirements for successful message transmission of information and entertainment could be met by the resolution response of the American standard proposed, accepted, and now widely used.

E. The fidelity requirements of INSTRUCTIONAL messages may be greater (require a much higher resolution) than this general standard. Maps, charts or other pictorial materials and objects require much higher resolution than the American Broadcast standard provides.

F. Other countries employ resolution standards higher than the one used in the United States and closed-circuit installations (usually found in industry or military use) frequently have much higher resolution.

G. Every single frame of a 16mm film has more information contained on it than any single television frame can possibly show...if it is an American Broadcast standard system of television.

This information puts a light on television which is exciting and seldom found. Borrowing from the above mentioned publication (and using the seven summarized points it brings out) the research staff sets forth these ideas:

2.1 A new and totally closed-circuit system could be based on high resolution standards far beyond those of the 525 line American Standard.

2.2 A new standard or non-standard system could compensate for the increased cost (caused by using more expensive components or components which are more expensive because they are not mass-marketed) by handling messages which lesser resolution systems cannot successfully handle i.e. book pages, detailed maps, and drawings and EVERY other visual, regardless of its intricacy and detail.

2.3 A system might be designed in a manner which allows changes from low to high resolution only on the occasions in which high resolution is demanded.

Note: The research staff has seen equipment *manufacturers who have cameras that can* be switched readily from 525 line standards to much higher resolution scanning systems (and back) at will. It follows that cables and playback equipment might also be used in a variable-resolution fashion. Elsewhere in this report the subject of bandwidth is covered in cursory fashion. It is mentioned in passing here, because of its relation to resolution: A 20 megacycle bandwidth message carrier (high resolution) might be split into five 4 megacycle bandwidth message carriers upon occasions in which low resolution can be tolerated when ordinary gross images are to be passed. Engineers can quickly show how such a suggestion is easily made, verbally, yet difficult to actually perform. However there is merit and possibility in the suggestion.

2.4 Much production cost of instructional programming could be reduced by use of high resolution television on standards. It is believed that objective study would show that graphics technicians preparing visual material for television programming spend more time in converting (simplifying) readily available visuals to the forms required by American Broadcast standard television's weak eye. Reducing detail, broadening lines, changing gray scale, changing perspective ratio. these activities consume more time than the creation of new visual material. This accounts for much of the expense if the television unit is supplying adequate visual support to programing. Many good radio programs are presented on television because of the time and cost of this conversion-for-low-resolution-use process Much non-visual programing is blamed on unimaginative producers or television teachers when blame rests squarely on the high cost of low resolution visualization.

Of course millions of low resolution black and white television receivers are turned on every day in and out of the field of education. Those receivers display excellent picture-sound message quality which satisfies the fidelity requirements of those messages carried. Just as the research staff feels that an urban area needs at least 150 simultaneous channels (a point bitterly contested by some respected professional engineers and educators), it also feels that instruction requires a much higher resolution system than that presently being used, by those same professionals.

Fortunately there are confirming opinions to this contention.[1]

3. Ease of use by teacher and student.

"Ease of use" is interpreted by the staff to mean that administrative and technical features must accomodate needs with the expenditure of little energy, time, skill, and attention by the teacher or student as possible. Although some energy, time skill and attention is inherent in any search-retrieval-use system an "easy" system might be:

3.1 The user can assume the scope, kind, and level of information or "canned experiences" is limitless. He need not learn catalog use, requisitioning, techniques of complex order, or methods of cross-index searching He needs only state "I am interested in (delineate the topic of interest) and I am of (specify a level of comprehension capability)". This interest statement should be in as simple a form as possible. It should be verbal if possible, or perhaps a coded input to a data phone if necessary. All search, elimination, cross reference, and selection should be done by machine techniques.

3 2 The result of the search must be made known in a useful form to the inquirer. Perhaps the data processing

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[1] Standards of Televison Transmission, NAEB Journal, June 1954, p.9 ff.

accounting machine or electric typewriter printout techniques might serve the purpose. Whatever the method it must be QUICK and satisfying in form.

3.3 Such a printout must give whatever infomation is needed in whatever form needed to allow easy and quick selection of the resources available on the topic searched and at the level of comprehension appropriate to the inquirer's ability.

3.4 Quick and easy input (ordering) of the selected materials (perhaps by use of key punching of code numbers) would then complete the ordering process.

3 5 Quick response to the order in an appropriate display form (paper print audiotape, or videotape) consitutes the easy to use delivery form. The form should be durable enough for delayed perusal as well as immediate use. It should be observed on simply operated machines (yet unbuilt-videotape recorders, one-switch audio tape recorders or directly read prints). As few devices as possible should be used to display any sound, any picture, any movement, or any combination of the three, for single student use or mass audience use.

Note: There are electronic systems of instant-access style for retrieving audio, pictorial or coded information on the market.. .if one is willing to pay for the apparatus required for INSTANT access. The staff believes that so few legitimate demands are present for truly instant access that the high cost of totally automated systems is unwarranted. Even a five minute delay between order and delivery is tremendously less expensive than instant access and longer delays are proportionately less expensive. There is a point at which the delay is intolerable if the user's readiness is to be even approximately honored. It is suggested that a system which can give instant retrieval on a few materials, one hour delayed retrieval on others and 24 hour delayed retrieval on the rest (the bulk) of materials might be economical and adequate.

By contrast, some of the elements of current systems show uses which do not seem satisfactory:

3.6 The user must transport himself to the depository and use items within the walls of the depository (variations on this are rampant).

3.7 The user must do many drills in requisitioning materials which are not actually part of the ordering system but are part of the order processing duties of the depository. (multi-carbon single-item-per-form requisitions are not necessary. They expedite order processing by transferring the time and cost of paper work from the processing clerks to the person completing the order. For example, the cost of three minutes of time consumed by 5,000 teachers is greater than the same total time of a few clerks.)

3.8 The user must filter, sort, eliminate, cross-refer, and otherwise frustrate himself in the act of searching a catalog or catalogs to see what resources are available to fulfill his interest and level requirements.

3.9 Planning for use must be begun weeks prior to use if the order is to be transported to depository, processed, and delivered. Return after use is bothersome when one prefers to get with the next thing in mind.

3.10 Actual display of the resource material for consumption of the message frequently requires competitive scheduling the use of veritable arsenal of equipment, setting up machinery and altering the environment, operating diverse and complex (and sometimes ill-repaired) machinery, and disrupting the continuity of student thought which may be established by long and arduous effort.

Ease of use is certainly a very relative term. Currently, high use of audiovisual materials is an indication of the worth of these materials and testimony to the endurance of teacher and student patience What might the volume of such use be if pre-scheduled telecasting, multi-machine using, and complicated search and retrieval were not the order of the day?

4. Virtually infinite capacity for total message handling and high capacity for message handling during a 24 hour period.

Elsewhere the subject of multi-channel telecasting is mentioned. A useful system which can satisfy individual as well as group needs at all grade levels, in all subject areas, in all message forms, and in quick response to stated needs....must be multi-channel of a high order.

Some messages involve motion and sound. Others involve still pictures with no sound. Still others have sound and no related visuals. Because of the differing nature of these messages, different "subsystems" might be used to develop a multi-channel multi-purpose system. Considering the large quantity and wide array of messages and population to be served (not once but on the occasion of each desire for information retrieval) the multi-channel approach and multi-media use seems natural.

Simultaneous night and day use of the following facilities. is presumed:

A. 15 educational licensed FM radio stations (each sending 3 messages, simultaneously, by use of the sub-carriers,)

B. 31 channels of 2500 megacycle television with each channel being re-used in as many as 8 locations of the same metropolitan area, simultaneously.

C. hundreds of common telephone line links.

D. hundreds of coaxial cable runs,

E. 25 or more microwave links,

F. and 1 open-circuit educational television station.

After reading the above list, "multi-channel" might seem astronomical. To most persons "multi-channel" means two-three-four and at most six channels. Even the above wholesale use of message routes may need extension by high-speed transmission and multiplexing techniques in order to be adequate.

The ACTUAL number of audio and televison message routes can best be stated by the following "formula" : As many as necessary and as few as possible. It is the same formula that must be followed for any economical and useful stocking of equipment.

Four factors determine the number of simultaneous message routes needed:

A. The total number of messages to be delivered

B. The length of transmission time each message consumes.

C. The amount of time (in each 24 hour period) in which message transmission can be performed.

D. The maximum delay allowable between ordering of materials and delivery of materials.

A worthy system would have the potential of handling:

A. Thousands of messages of various kinds in any 24 hour period.

B. Variable length messages (averaging 20 minutes per??)

C. Twenty four hour operation.

D. No more than twenty-four hour delay between initiation of order and delivery of message. In some cases no more than five minute delay.

Given those specifications, the extremely high multi-channel requirements are reasonably stated.

5. Reliability of system components.

Little need be said of this characteristic. As long as a hardware component fails, operates erratically, wears out or otherwise falls short of "once installed, immediately forgotten" caliber, the system will be unsatisfactory. To the extent that it is unreliable it is unsatisfactory. Without the financial resources to pay for the reliability that space-probing scientists, military scientists, and large-industry scientists have at their command, education will have to accept the "reasonably priced" and relatively unreliable hardware such a comprehensive system will have to have sprinkled throughout. (Unless a sudden raising of sights and raising of funds springs forth).

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limited number of open-circuit televison channels is a current trend which still has every problem local open-circuit television possesses and more. The need for such state and nationwide coverage is unquestioned, but the method and results-versus-cost aspect seems suspect. The North Circle concept for urban area coverage ADDED TO current open-circuit state network plans may suffice for a starter. However, the disparity between urban and rural school resources will be magnified in such case. High-volume and random-access in the cities and pre-scheduled low-volume message carrying in outstate regions must necessarily contribute to a greater difference in opportunities for good education.

Since, within reason, a microwave hop is a microwave hop, regardless of intervening distance, the potential of serving rural areas with the urban system described in this report seems worthy of further study.

Within the geographic area actually covered by the system, tapping into cables which pass near a newly-built school or putting up a receiving antenna on such a new school is relatively simple and inexpensive. As with water, sewer phone, and electrical service to a community, installing the initial system accounts for the great cost and amount of work. Tapping into such utilities to serve a new house later is a relatively simple and inexpensive operation.

8. Relatively short time interval between ordering and receipt of

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instructional materials.

Pre-scheduled materials distribution (no matter how well planned) found in educational radio and television programming has so little time relationship to learner readiness that any logistical system depending on such pre-scheduled open-circuit methodology seems doomed to fail. unless coupled with in-school recordings made for delayed use.

The scheduling problem of television and radio is usually seen only as a mismatch of minutes. Wishful thinkers imagine that schools need only shift class schedules five minutes this way or ten minutes that way and all will be well. This is naive on several counts:

8.1 Shifting. on a large scale will never occur. Bus schedules, special personnel schedules, lunch schedules, use-of-special-facilities schedules, and countless other administrative factors necessitate the diverse scheduling found from district to district and school to school. Many of these factors bear greater weight in schedule development than does television. Most administrators decry these influences on the timing of teaching and begrudge any added factors which would complicate scheduling.

8.2 A shift of bell schedules a few minutes one way or other couldn't account for the fact that the disparity is not only

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> in broadcast time-class time. The televised program may be the wrong semester, wrong week, or at least wrong day instead of the wrong minutes in the day. Class A finds a field trip appropriate this week; next month the television station is presenting the correlated television lesson. Class B may be studying the state constitution this semester; the television series on the subject is scheduled for next semester.

Since shifting of bell schedules will not be done and could not suffice even if done, many broadcasters employ repeat program scheduling to compensate for this disparity in television time-readiness time. Repeating a lesson at different hours in a program day or days in a week undoubtedly doubles or triples the opportunity to match television time-readiness time. Even so, this assumes that there are only 2 or 3 schedules of instruction. Upon charting the bell schedules of the high schools in this urban area, a member of the research staff found that there was no two-minute time span in any school day during which some bell was not ringing somewhere. There are hundreds of bell schedules in the elementary schools of a given urban area and more at the junior and senior high school levels. In addition, repeat telecasting limits the time available for programing to different audiences. A typical school day schedule for open (and closed) circuit telecasting is limited to 15-20 programs per day. Using the higher figure, this means only 100 programs per

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6 Flexibility for handling all kinds of pictorial, auditory and coded messages.

Point 2 above states the ability of a high resolution system to accept ANY degree of picture complexity regardless of form (photo book illustration, etc.). In THIS instance, flexibility refers to form in which the message is stored. Manufacturers of television camera equipment have managed to accept any visual form and transfer the image to the camera pickup tube. The catalog of most camera firms include such accessories as necessary to televise microscopic slides, films graphic copy and other stored visuals. Some amazing accessories include explosion-proof housings, remote control operating, weather proof housings (right down to the windshield wiper) and sewer-crawling cameras. Distance is no problem (from millimeters to Mars); size is no problem (from microscopic to ...Mars); exotic form is no problem (from a print manual to Mars). Generalizations are often dangerous, but one is ventured here: ANYTHING, ANYWHERE, in ANY FORM can be televised.

7. Ability to be easily extended to additional classrooms regardless of distance or location.

Through use of microwave transmitters, telephone company cables. FM stations and/or 2500 megacycle transmitters, the dataphone inputs and audio and video outputs can be placed in

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new locations to extend or fill in coverage of the system. Current methods call for "another locale, another library" and "another locale, another record center" and "another locale, another array of audio visual hardware". The centralized and shared concept of data handling and materials storage of the proposed system facilitates extension with minimal cost. In fact like utility companies, it finds greater efficiency as the clientele increases.

It is conceivable that two metropolitan areas, using this system, would inter-link and serve areas around and between themselves. Kansas City and St. Louis (having the bulk of Missouri's student population) might form the basis of a statewide network of much greater use and economy than the current statewide open-circuit TV plan being considered in Missouri.

If all the intervening urban areas were to share the cost and use a trunk line from the Library of Congress to St. Louis might be established. Students and teachers of the Greater St. Louis area would then have access to the 140,000.000 volumes contained in that super-library. Letting students use its more-than-modest book library by transmitting facsimiles thereof might be the least expensive and best federal aid to public education Congress could support.

Statewide and nation wide instructional television predicated on the mail delivery of kinescopes and videotapes or by an extremely

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school week and 3.800 programs per school year can be presented on a single channel. Considering that the two trucks of the St. Louis County Audio Visual Department delivered 92,000 films (motion picture counterparts of television programs) in the 1964-65 school year this shows the small opportunity of open-circuit television to serve a great scope of topics and maturity levels. Any encroachment on television program expansion made by repeat-scheduling is at great cost to its capacity to deliver even 3.800 different messages. Repeat programming has not solved the scheduling problem.

As stated before, recording on the school end of the radio or television line seems the only plausible way of adapting pre-scheduled materials delivery to learner readiness-schedules. "Record it when it comes and play back when useful" is the only rewarding avenue for reducing or completely solving radio and television scheduling problems. Such in-school videotaping and audio taping for delayed use more than solves the problem of pre-scheduled scheduling. it also provides opportunities for expanding the usefulness of such open circuit facilities:

8.3 Radio and television programming could occur all day and all night....seven days a week. Such programming

school time and at the readiness time of teacher and student.

8.4 The same recorders could capture films and other instructional materials sent out on the closed - circuit multi-channels night and day. They could catch "Profiles in Courage" on Sunday evenings for playback during Thursday morning's class in history.

8.5 Coupled with simple camera equipment , the in-school recorders could capture demonstrations of frog-dissections, ballistics tests, metal-lathe operations, and endless important or complex experiences to be shown again and again.

There is a vivid and important analogy between "live" use of radio and television programming and prehistoric food supply worthy of note here. Prehistoric man killed beasts for food. Large beasts provided more food than he could eat before the meat spoiled. As much as 95% of the meat was wasted in each kill. Yet he hungered between encounters. When he managed to salt, can, add chemicals and freeze meat, man was able to consume up to 95% of the meat on a delayed-use basis. That's efficiency. Feast or famine was no longer true.

Radio and television programming, not supplemented by salting, canning, chemical addition or freezing, is feast or famine updated. Unless the learner hungers at the time the meaty information is travelling through the air, he starves; even though his hunger may occur tomorrow or next week. Meanwhile the programs decay in the ether, 95% untouched or untouched by 95%.

Audio and videotaping of pre-scheduled broadcast materials can increase the low efficiency of such broadcasting to a point where we can witness the arrival of radio and television in their fullest potential. Potentially, there is no cheaper or better way of mass communication than open-circuit radio and television.

To have audio and videotape recorders located in schools as commonly as today's 16mm film projectors represents an important part of the "fast" access system proposed in this project. Allied equipment, such as a facsimile machine which can make high speed prints of still visuals off television and disc video recorders, is equally important.

Presuming that the bulk of materials will be expected by the teacher or student for use 24 hours after initiating the order for the materials, the recorders would facilitate shipment when a circuit is open to that school at some time prior to the 24 hour limit. Those materials which require use in much less time would be given routing priority over the circuits. And, true random-access materials-needs would have to be ordered by one of the various dial-and-you-get-it systems connected to juke-box-like storage machines.

To handle fantastic volumes of materials over an equally large and complex system with a great number of input-output stations (schools, classrooms or homes) the system obviously requires use of computers, data storage machinery, multi and random access facilities and sophisticated automation equipment. Optimistically, the research staff believes that input-output, storage, computing, record-keeping and other functions can be accomodated by present day hardware. Time and technology favors development of more compact and economical hardware in the future.

Feasibility study must be deferred until the requirement study is completed. The staff is sure such data processing is possible it is unsure yet of its feasibility for today.

9. Flexibility regarding location and type of input.

Actual pre-recorded instruction (television programs videotaped) would be stored and grouped with other pre-recorded instructional materials such as films, records, books, pictures and the like. Input into the system would be through "telecine facilities". These facilities are composed of row upon row (as needed) of 16mm film chains, videotape recorders, microfilm projector chains, slide chains, and other necessary arrangements of hardware for picking up by television cameras both sounds and pictures from their storage form.

Input of new or stored administrative data (inventories, student records, financial records, and the like) would be by necessary code transmission originators such as data phone. punched tapes. mark sensing devices. computer cores and magnetic storage systems.

Input of instructional programing, which has not been hitherto recorded, would be by television studio-control facilities much like those found in present day closed and open circuit television installations. Vidicon, Image-orthicon or other kinds of camera pickups would be involved. The usual array of studio hardware would be necessary. Each production facility would range in cost from $15,000 to $50,000 or more at today's prices. These are the "work horse" production facilities envisioned. Through cooperative ownership and use, they would number no more than 10 in Greater St. Louis at full implementation of the system. Although there are at least 40 public school districts in St. Louis and its surrounding sphere of association, it is believed that 10 facilities would accomodate the production needs if night and day production on a shared-use basis can be achieved. The 26 school districts of the St. Louis Suburban Area cooperative would share no more than eight of these production facilities. This sharing of production facilities forms the basis of the "circle plan" from which this project gets its label "The North Circle Plan". Neighboring districts contained in a geographic area of approximately 4 to 8 miles diameter and generally shaped like a circle become the other "circles", junior cooperatives, or whatever useful term might apply.

Hopefully, each district might do programing in these production facilities on a cooperative basis. That is, districts would discuss production plans and make agreements which would avoid two or more districts producing identical programming while leaving voids in other subject areas.

One arbitrary arrangement made by the research staff of these possible "circles" in suburban St. Louis follows. The actual composition, if the system were to be activated, would depend on the districts' decisions:

North Circle

Berkeley
Ferguson-Florrisant
Hazelwood
Jennings
Kinloch
Riverview Gardens

Center Circle

Brentwood
Clayton
Ladue
Maplewood-RH
Normandy
Ritenour
University City
Wellston

South Circle

Affton
Bayless
Hancock Place
Kirkwood
Lindbergh
Mehlville
Valley Park
Webster Groves

West Circle

Parkway
Pattonville
Rockwood
St. Charles

The city of St. Louis or "city circle" would be composed solely of the St. Louis district because of its size. Madison, St. Clair and Monroe County public schools in Illinois might form two or more additional "circles".

The basic reason for "circle" operation is the inherent economy in shared-use and shared financing of relatively expensive hardware and personnel having greater load capacity than would ever be used by a single district.

Future phases of the project will support the firm belief held by this staff that mobile facilities should be the basic form of production in this system, rather than fixed studio facilities. This view is contrary to all present operations (open or closed, commercial or educational) found in the country, except the Sports Network facilities. Most professionals believe that a fixed studio should be established and remote pickup facilities should be added when financially possible. Without further discussion at this time, the staff points out that experiences worth recording do not occur in the artificial chamber established as a "studio" ....they occur out in the surrounding world. Fixed studio operation is not necessary, it is just traditional.

The "work horse" or circle's production facilities (mobile or fixed studio) forms the basic input of original production of teaching materials. Supplemental "live" inputs or facilities for recording instruction would be available from the greater facilities of the open-circuit educational television studios within the community. Careful coordination must be undertaken so that the open-circuit studio and closed-circuit production facilities would do those things which each can do best. Presently, most closed and open circuit installations have a competitive or apathetic regard for each other's operations. There is a compatible and complementary relationship between open-circuit television and closed-circuit television which can be efficient and enjoyable.

Other instructional inputs would be made by lesser camera pickup facilities. In-school portable equipment could serve "single concept" program needs or elemental production requirements. Videotape recording of demonstrations, amplification of tiny things, taping of activities for self-study and all the small or extemporaneous uses of television could be accommodated by the one-camera portable rigs located in schools.

The foregoing shows there are legitimate uses for (and logical relationships among) in-school, in-district, in-neighborhood, in-community, in-state, in-nation and in-world levels of instructional television operation. The research staff uncovered no great efforts being made to study the interrelationships of the various kinds of television and levels of operation. Such a study is strongly recommended. This project is, in part, a preliminary phase of such a study.

The interlinking of the "circle" is an obvious move. Resources and resource persons available to "have" districts could be made available to "have not" districts. Team teaching could be conducted on an area-wide basis rather than only on school-wide terms. Best deployment and use of rarely-found superb teachers and guest experts would be facilitated. "Consolidation" of districts could occur in the realm of instruction even though political consolidation might be impossible.

"Eaves-dropping" on productions made by other districts will be an objective, not something scorned. If a high number of channels are operative, each district would have as many channels as it needs to suit it s scheduling and curricular needs AND can supplement its own programing with dozens of other programs originated by other districts.

All day long, hundreds of simultaneous closed-circuits could be routing instruction inside, between and among districts. All night long, this webwork of communication could be routing instructional materials being delivered to the schools. Depending on the number of channels used, the instructional, materials-distribution, and data handling needs of an urban area could be met by a single system of communications.

10. Ability to service non-school population for inquiries and retrieval of information.

It is conceivable that the local public school inquiry-retrieval station may replace the local public library. It is even possible that this trip to the school may be avoided if inquiry-retrieval stations could eventually be placed in the home.

All attempts at giving book mobile, branch library, television, radio and home instruction are earnest efforts to take experiences and information to the learner. Other styles of educational endeavor (including the public school systems themselves) necessitate the learner taking himself to the source of knowledge. In this respect, the proposed system is designed to outdo the bookmobiles, branches and stations in doing what they are trying to do. Their efforts are laudable, but, the splintering to sub-units necessarily splinters their ability to serve. They are decentralized resource centers with centralized selection. The proposed system is centralized storage with decentralized selection and access.

Many authors state a good case for the need for cradle-to-grave training and re-training if we are to avoid obsolescence in a changing world. They say we are training youths to take jobs which will not even exist when they are on the labor market and we are trying to ready youths to take jobs which do not yet exist. The case is strong and believable. If cradle-to-grave formal or semi-formal learning is a requirement, this proposed system holds great promise.

Course instruction being televised anywhere could be brought to the school-aged or adult learner if a high capacity multi-channel closed-circuit system were implemented. It might be broughtright into the learner's home. The living room might become a synthetic science lab or technician's shop in the same manner that a non-equipped school room can temporarily be a demonstration lab via television's ability to bring along the special apparatus needed for the demonstration-of-the-moment.

If every man and woman in our city, state, country and world must undergo continual training and re-training, we cannot rely on the concept of having learners transport themselves to the source of information. The financial capacity to build school housing for present-day student populations is hopelessly inadequate. It is unthinkable to attempt housing all mankind in school buildings; yet the current rapidly-growing moves into adult education follow this very path. Must man have a living-house AND a learning-house? Utopian as it may seem (and debatable as the idea may seem) a living-learning-work house is a logically sound concept. Psychologically, it has little appeal at the moment.

To devise and build a teaching-materials distribution-data handling system of the generous proportions proposed here, and yet restrict its use to the formally enrolled public school population, would be as short-sighted as if Congress were to contend that its 140,000,000 volume library is for its own research purposes and would be closed to outsiders. Interconnection of ALL schools and resource centers and access by ALL the population is the ultimate use to be sought.

11. Ability to be current and apace with curricular changes.

No useful system (especially one of such a probable cost) can be less than current. By using data processing techniques, rapid entry, announcement of availability and access would be possible. Change must be quickly accommodated. If the system can approach the hope of tapping every resource center in the country, it can have quick access to every new material representing such quick change.

12. Ability to keep materials in good repair, or near-perfect condition.

As long as materials are physically shipped and displayed in many machines or handled extensively, there will be billions of dollars spent on repair and replacement of instructional materials. Not one of those dollars will contribute to the instructional program.

If facsimiles of master copies can be sent, the disposable facsimiles (sounds, television pictures, erasable recordings, and low cost paper prints) will not have to be repaired or replaced. The master copies, stored under the proper temperature and humidity conditions and transmitted by trained technicians on excellent machinery, might last as long as the Declaration of Independence original.

To realize the full and tragic cost of repair and replacement (the basic reason materials centers cannot gain larger scope of coverage) it is necessary only talk to a record librarian, a film librarian or a book librarian about their repair programs.

Centralized storage (proper storage assumed) and FACSIMILE transmission of the message is an important characteristic of the proposed system. There is no message in wood pulp, acetate, silver oxide, plastic, cloth or the other ingredients in instructional materials. Only the messages borne on these carriers has instructional worth.

Presuming that the complete message, down to the tiniest ingredient, can be transmitted by the proposed system, there is no contest as to the logical choice as a message carrier: transmitters and cables versus cloth, paper, silver oxide, acetate or anything. It must be realized that these ingredients are methods of STORING messages. A film is a STORAGE DEVICE. Television is a MESSAGE CARRYING DEVICE. Those who argue the merits of films versus television are comparing apples to oranges. Films versus television TAPES or TRUCKS versus television; those are the comparable elements to argue. . .if one must argue about comparative merits. The actual message carrier (in a transport sense) is the truck, train, plane, or walk-in customer who does the transporting.

No one wants to read a book: everyone wants the messages stored in books. No one wants to see a movie; everyone wants the visual and auditory experiences stored on films. Only those who find the storage form more important than the messages stored can be at odds with the concept of facsimile transmission, recording and display. Those people who are librarians (making a living handling these materials) the commercial interests (who make money selling added copies, replacement copies and repair supplies for these materials), and the authors of these materials (who get paid on the basis of the number of materials-copies sold) will be drastically affected. Each and every such interested person might find new financial reward-bases if he were willing to try. But since each is presently profiting, not on the materials' message, but on the efficiency with which such messages are stored, distributed, handled and administered in general, there has been little incentive to try.

13. Ability to eliminate or reduce multiple copy buying where possible and also replacement of materials due to damage.

This characteristic, an extension of the last, refers to the inefficiency which accompanies physical-shipment-of-materials operations. When two or more learners or teachers compete for access to a single material, one or more must be disappointed if sufficient copies are not available to satisfy each competitor-for-use. Such need for multiple copy buying is as expensive (or more so) as the replacement and repair due-to-damage aspect mentioned above.

This waste is repeated in every system in which materials rather than facsimiles are shipped, be they books, films, slides, records, tapes, or otherwise.

The proposed system approaches the ideal of making one copy serve as though it were 1,000 copies when required (through opening of as many distribution channels as required, or repeated delivery in a short time span). When no copies are desired, this single copy occupies only one slot on a shelf and awaits its next use.

When a person walks into a book library he sees books. When he walks into a film library he sees films. The thought seldom occurs to him that the books or films he sees are not being used. The more copies he sees of any one title, the greater the waste.

This waste can be reduced to the barest minimum if a system which requires only one master print of each title could be employed.

The cost of storage space, shelving and handling in multiple-copy storage centers can be evaluated without further elaboration. Much of this cost is, literally, hidden. When multiple copies are stored in shelves, closets, and sub-libraries, the total storage and shelving requirements are not apparent in a single view. Combine the few cubic feet devoted to such multiple copy storage throughout all the public schools of our country and there would be an assembly place large enough to accommodate the population of New York City.

14 . Ability to transfer human manual operations to machine operations in every instance where greater efficiency can be gained. Ignoring the argumentative thought of causing further unemployment due to automation and considering only the efficiency desired, the desirability of automating a logistical system is automatic. The high speed, large volume, short time, and accuracy required by the proposed system dictates use of automation techniques. Machine-versus-human studies would have to be made to determine where and when humans or machines should be employed.

A recent publication on programed instruction contained a sentence which read "If a teacher can be replaced by a machine, she should be". Often misquoted or quoted out of context, the sentence brings chuckles and frowns. . . according to the new context, or lack of context. There is a deep and important meaning to this maxim. Human resources are so valuable and scarce (speaking of the caliber needed) that each mechanical chore which can be taken away by machinery SHOULD be taken away, thus freeing the human to exercise those characteristics which no machine does possess or can possess. As such a move creates new opportunities for use of human resources, it also creates new problems. Consider the arithmetic teacher who has all presentation of facts and demonstrations of processes taken away by pre-recorded materials, take away also, all drill supervision by using autoinstructional machines; and take away paper grading by using machine scoring. What is there left for the arithmetic teacher to do? Teach! Teach what? Teach how? These are new and difficult questions. If properly answered, public instruction can reach a new higher level of worth.

As for the non-teaching staff which might be replaced by machinery, it is needed in greater quantity and with greater skill in this proposed system than in any current systems. This very fact is proof of the contention that life long training and retraining is now required of all. Truck drivers can be videotape recorder operators. Schedulers can become key-punch operators. There are numerous places in which human resources will be necessary.

15. Long range economies in terms of cost per message carried in each category: instruction, materials distribution and administrative data handling.

Cost is a relative thing. Price is exact. Current prices of components for the proposed system are useless unless immediate construction is anticipated. Since immediate construction is not possible, current pricing of the proposed system would be more work than it is worth. Naturally, some speculation (based on current prices) was made by the research staff. At least $12,000,000 would be required to equip such a system for metropolitan St. Louis. Even more would be needed to staff, operate and provide consumable supplies for the system. Whether the system is financially feasible or not, depends on more factors than just price. As stated in the preface to this report, $500 is too much to spend on a system which does not give $500 worth of service and $50,000,000 is not too much to spend on a system which gives more than $50,000,000 worth of service.

If the message-handling capacity and more subjective measures of the proposed system's worth were predicated on today's prices (with tomorrow's workload) no sensible cost per message could be derived. Likewise, tomorrow's prices of the proposed system applied to today's workload would be unfair or of little use.

The only reference to financial feasibility of the system proposed in this report appears here. Financial feasibility cannot be determined without further study. If further study shows that system cost-per message handled is significantly less than any current or alternately proposed system, financial feasibility will be assured.

If this system is expected to co-exist with present film libraries, book libraries, bookkeeping and record handling offices, it is expected that the system will not be financially feasible nor administratively desirable. Only if considered as a total SUBSTITUTE for currently chosen operations can the cost per message be significantly lower than current systems. This is, hopefully, a BETTER way to do that which is being done or will be done . . . not an ADDITIONAL way to do things.

The cost of instruction by television is greatest (in terms of messages handled, capital outlay, training requirements or any other measure) in the beginning. A television set bought for the purpose of receiving ONE open-circuit educational channel is much more expensive than a set bought to receive ten or twenty channels. Conduit and wiring which distributes ONE open-circuit educational channel is much more expensive than the same hardware which simultaneously distributes 12 or more channels. Television production studio facilities and related control gear is much more expensive if it is used to do 5 productions a day than if it were to operate night and day with programs "back-to-back". All this is true also of computers whose full capacity is unused, books and films whose use is minimal or any other resources.

Usually waste of a valuable or expensive resource is due to the ineptness with which the resource is handled. For example: 6 hour days, 5 day weeks and 180 day years is one of public education's most inept practices in handling building-use and equipment-use. Much "live" television programming is wasteful of the production time and cost. Much foreign language-only use of language laboratories is a waste, considering their future usefulness for spelling, shorthand and other drill work.

Current practices must undergo great revision or must be eliminated entirely if financial feasibility of the plan is to be found. Psychological factors must be modified or eliminated if great use (contributing to financial feasibility) is to be made of the proposed system. Perhaps human problems, rather than the tremendous technical, legal, administrative, financial, and educational problems, will be the hardest ones to resolve.

To avoid falling into the trap occupied by too many public school support facilities, it is suggested that the proposed logistical system be activated because it IS feasible rather than because it CAN BE feasible. If that condition of feasibility does not exist for ten more years, the system must wait. Building on paper, planning and preparing can be the important activities for the intervening years . . .without much cost or risk.

16. Efficient employment of "exotic" and expensive staff and hardware through cooperative use of both.

Closely relate to, and bearing upon, financial feasibility of the proposed system is the question of financing and use of physical and human resources.

Aside from any federal or private funds which may contribute to construction and operation of the system (experimentally or operationally) the clientele served by the system must bear the basic responsibility for its financial support. In a district-owned, district-operated, and district-used system of closed-circuit television, the obvious support agency is the district i.e., the taxpayers residing therein. The proposed system depends on a shared-ownership, shared-operation, shared-use system concept which calls for shared-financial support.

The concept of cooperative ownership, operation, use and support has been employed by the suburban public school districts of the metropolitan St. Louis area for 34 years or more. In the last five years, this concept has been formalized and emphasized through the Cooperating School Districts of the St. Louis Suburban Area organization. In addition to film library service, instructional television program service via open-circuit television, technical and vocational training, and other less concrete or expensive facets of its activities, this organization engages in legislative, legal, research, and coordinating activities of mutual advantage to the 26 member districts. They do together those things which they could not economically or efficiently do independently.

Other districts in the United States have variations of the cooperative approach used by suburban St. Louis districts in operation. Some enjoy very satisfying results from the curricular, administrative and operational ventures they support and use in common.

If district _A_ possesses a resource whose capacity is not fully used and district _B_ wishes use of such a resource _A_ and _B_ should consider cooperative use and financing of the resource rather than duplicating the resource in both districts _A_ and _B_. If neither possesses a desired resource, *A* and *B* should consider a joint venture if both needs can be served at appreciable savings. If no appreciable savings can be effected by such a venture or if VALID existing circumstances prevent such cooperation, then duplication is warranted.

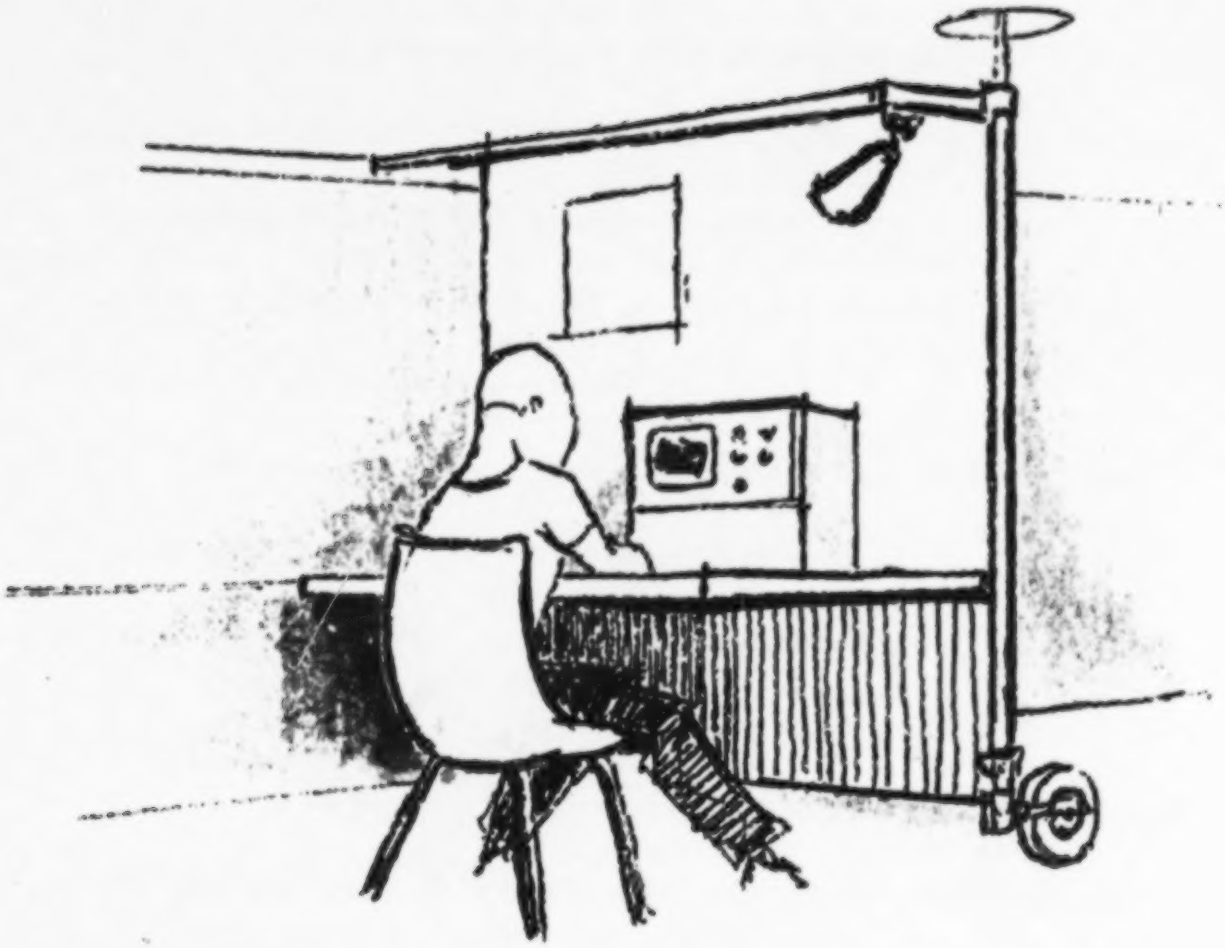
The preceding paragraph says, clearly, all that needs to be said. Any elaboration would be superfulous. Today short-sightedness, self-interest, and apathy prevent the cooperative approach from being taken more broadly in public instruction. If these factors continue to forestall opportunities for economic use of resources, the proposed system may not be found financially feasible. Perhaps problems will become critical enough that the taxpayers will refuse to suffer existence of short-sightedness, self-interest and apathy in public education.

A visit to any closed or open-circuit television station, will demonstrate that such installations are expensive, little-used (as related to their capacity to be used) and contain the potential for broader use and broader support in a cooperative manner. This would be highly beneficial to those who now use these installations and those who might share their future use.

17. *Versatility in output form to satisfy requirements for one time or many time use of delivered messages.*

Temporary or transient observation of the message may be all that is required by the teacher, student, or administrator. If so, television screens and loudspeakers or headphones will be the total assortment of display hardware needed by such a system. If a continuing reference is required, a durable and suitable storage form will be essential. The form may vary for different kinds of messages and different kinds of use. Cheap disposable paper prints, magnetic tapes, enlarged printed visuals, paper masters for further machine duplication, easily filed discs or other low-cost non-returned storage forms may be needed. Foolproof, durable, light, small, effective playback devices would display those items which require "translation" or projection for message display.

If an administrator wants to know the balance in an account, how many students in section Z of biology, the number of light bulbs on hand, or what his fifth grade teacher thought of eleventh grader, Bob Jones . . . he must be given the information in a form which meets his needs. At a recent meeting, a noted librarian asked how the system might allow a student to browse. Before an answer could be formed, a member of the audience contributed "push the browse button" and laughter ensued. The librarian was serious and the heckler was right. If there is a value in browsing, a method of browsing must be provided. There can be such a method.



SECTION FOUR

SECTION IV

DESIGNING NEW METHODOLOGY FOR OPERATING IN PROBLEM AREAS

There are problem areas to which currently employed methodology provides inadequate solutions and this is a basic thesis of the North Circle Project staff. Designing new methodology to replace (in part or whole) current methodology is the task to which the North Circle Project has addressed itself.

The seven designated problem areas can be sorted into three categories:

1. Instructional problems
2. Instructional materials access problems
3. Administrative data handling problems.

This grouping into three types suggests that three methodologies must be developed. This may be true. The project staff believes there might be a methodology which, with minor modification, can serve ALL THREE groups. That is, a hardware system and procedure of operating which might solve instructional problems MIGHT, with minor supplement, be a desirable hardware system and procedure of operating for solving instructional materials access problems. For instance, hooking all classrooms together, throughout the county, by closed-circuit television links might solve instructional problems. MIGHT NOT THIS SAME NETWORK SERVE AS A MATERIALS-DISTRIBUTION SYSTEM IF PROPERLY DESIGNED? Further, could this communications network be used, by minor additions, as an input-output link between schools and a data-processing center? If so, a single methodology (electronic intercommunication and transmittal of information) becomes a multi-purpose communicator for 1. instruction 2. materials access and 3. administrative data handling.

This section will present guidelines for developing a new methodology for solving problems in the area of INSTRUCTIONAL MATERIALS ACCESS. In developing such a new way of doing things, an attempt will be made to choose hardware, arrangements of hardware, and procedures for operating which might solve instructional materials access problems AND problems of instruction and administrative data handling, as well.

On the following colored pages is a description of a new methodology for solving instructional materials access problems. It was devised for illustrative purposes only. It may be close or far from "tomorrow's" logistical system for materials-handling. How close it may be can only be known after further study of its feasibility. Note how the two supplemental descriptions (Supplement #1 for instruction and Supplement #2 for administrative data handling) expand this materials system to the point where it becomes a multi-purpose methodology. If it were found to be practicable, and if it were to be financed and operated by neighboring metropolitan school districts it would be a "Cooperatively owned, multi-purpose, multi-channel television system for the production and transmission of instruction, instructional materials and administrative data".

A teacher diagnoses her student's readiness for an experience.

She employs a dataphone in her school's office to find out what instructional materials are suitable for her immediate need by encoding the bits of information: the maturity level of her students and the topic .

The dataphone delivers the inquiry to a computer over a network of telephone lines which connect the school to the central processing center in this urban area.

The computer has been fed listings and descriptions of materials found in various materials depositories connected in the system. The listings are constantly being changed so that they are always current.

Film, book, audio, videotape and art libraries of the local metropolitan area have their offerings recorded in the computer's memory banks.

Also included are the descriptions of materials found in depositories in other cities which are connected to the local system by trunk lines.

Those depositories include the Library of Congress, Great Plains Regional Videotape Library, The National Tapes for Teaching Library, The University of Indiana Film Library and other remote centers housing large collections of instructional materials.

The computer searches its memory banks for those items which are appropriate to the immediate needs expressed by the teacher who initiated the search.

Students and lay members of the community could institute similar searches for materials by initiating their requests at the dataphone input stations in their local public schools.

The computer has now selected all the potentially useful listings pertinent to the teacher's needs.

Whether the materials are books, charts,photos, films, videotapes, records or what have you, a brief abstract describing each useful item and identification codes are sent back to the dataphone station at which the search was initiated.

Printout facilities would give the teacher the descriptions from which she can pick and choose.

Tomorrow's catalog is not a book or a card file. It is a computer.

Using the same dataphone station through which the search was conducted, the teacher now submits the appropriate ordering codes for those items she had selected.

The dataphone is channeling the requisition to the same data processing center, but a different program takes over the job of processing her order.

If some of the requested materials are to be delivered from a depository in another city the order is passed on by cross country circuits to the home of the desired material.

Locally, the computer is using the teacher's specifications to direct the timing and routing of films from one despository, paintings from a second depository and books from yet another depository.

Work orders are being printed out at the various depositories telling what is to be delivered by which circuit, at what time, and for whom.

Tomorrow's scheduler is not a blonde, nor a redhead. Tomorrow's scheduler is a computer.

Having received their orders from the computer, the materials centers go into action. Microfilms in the libraries spill their contents, in a selective way, into closed-circuit television channels and the television facsimiles of these tiny frames are heading toward our teacher's school.

Up in Nebraska, videotapes are pulled off the shelf and are microwaved down to our city's switching center for redistribution over closed-circuit networds to our teacher's school.

At the University of Indiana, a technician loads a television film chain for dispatching down one of the trunk lines connecting Bloomington to St. Louis and on to our teacher's school.

Meanwhile, in our local materials center charts and photos and other pictures are being selectively picked off the bands of a magnetic disc video recorder on which they have been stored. The visuals also travel the closed-circuits to our teacher's school.

Somewhere an audio materials depository starts dispatching its requested materials over the sub-channels of several local FM radio stations.

Still other audio materials are going out over telephone lines to our teacher's school.

Some audio materials are pouring into the audio carrier of a closed-circuit television link at the same time the video carrier is accepting still pictures which aren't even remotely related to the audio messages.

Within 24 hours of the teacher's original inquiry, dozens of simultaneous closed circuit channels are being activated between cities all over the county. . . all of them terminating at the switching center in our city.

And in our own area, hundreds of simultaneous closed-circuit channels are telecasting their materials to diverse locations, fulfilling the requests of thousands of teachers.

Some of these local channels are following cables leased from the phone company.

Other channels become 2500 MC signals, sending materials to several receiving locations, at once.

Some materials are being fed out over the local open-circuit educational television station. These open-circuit materials are those being requested by many many people at the same time or programs destined for locations not hooked into the closed-circuit network.

Looked at by eyes which can see the invisible picture and sound signals surging up and down the web of circuits, it looks like atoms gone wild in a metropolitan area wide molecule... ...and yet there is deliberate timing and routing to each and every message. Data-processing and automation of several sorts manage to keep order in what would otherwise be a jumble of messages.

Tomorrow's delivery system is not a purple truck. Tomorrow's delivery system is multi-channel closed-circuit television, multiplexed FM radio and open circuit teleivison.... timed and routed over hundreds of simultaneous channels by computers.

The messages are delivered night and day, seven days a week, summer and winter. They are held in the school on videotape and audiotape recorders for later playback by our teacher.

Since no materials will physically leave their depositories, our teacher will receive no disappointments. The materials CAN'T be out in someone else's school since they will never leave the resource centers.

Only television pictures leave the film library.

Only the sounds leave the record library.

And since the actual materials remain in the depositories they will remain damage free. No more torn films to repair; no more replacement of worn out prints every 10 years.

And buying multiple copies of materials becomes a thing of the past. A new marketing relationship will be established with publishers and producers. One profitable to them and to us.

If everyone wants a highly seasonal item at the same time, that item can be sent out many closed-circuit channels, simultaneously, and fill all requests with a single copy of the item.

The huge array of single purpose projectors on display at conventions and found in our schools will be obsolete.

Our teacher will have fewer and simpler devices to operate. Tomorrow's AV equipment will be reduced to television receivers, loudspeakers, headphones, videotape recorders and audiotape recorders. Because, no matter what the diverse form of input materials, all materials will be received as video or audio signals at the school.

Each school will receive the electronic signals, night and day, and hold them on audio or videotape recorders for later playback by teachers or students.

Book pages, photos, charts and the like will be copied off the television screens by high speed facsimile machines, thus converting the televised image to paper.

Some of these papers may become plates for machine printing of multiple copies for students.

Playback of the audio and videotapes will be through school distribution systems which link the tape recorders to classroom television sets.

If individual study is desired, the image can be channeled to student study carrels.

Materials having a constant rate of display, such as films or phonograph records, will be allowed to playback without interruption.

Materials having a variable display rate, such as book pages or filmstrips, will be triggered by the teacher or student to start or stop at will.

Some of the materials will be delivered over color television circuits if the materials content require use of color for proper understanding.

Some of the still pictures, especially books and detailed diagrams or maps, will be delivered over high resolution circuits which provide much greater legibility than the 525 line American Standard System.

This, then, is tomorrow's collection system and display system.

The basic parts of any system of materials handling in a large resource center are cataloging, order-processing, delivery, and display-to-learner.

Today it's the book catalog, the booking card, the truck and the tremendous array of audio visual machines.

Tomorrow the computer will be the catalog, the computer will process orders, closed-circuit television and other electronic means will deliver materials and magnetic recorders will hold them for later display by the teacher on TV screens, through speakers and on facsimile prints.

SYSTEM SUPPLEMENT #1 (INSTRUCTION):

Portable television cameras and microphones are checked out from school equipment pools by teachers who wish to record demonstrations on school-owned videotape recorders.

Later in the day these television recordings are played back to other class sections.

Later in the year the recordings are played back to second semester students.

Selected teacher-made videorecordings are deposited in the metropolitan area's library of videotaped demonstrations for use by other teachers in other schools.

The portable cameras are checked out by a team of teachers to simultaneously carry live teaching to a suite of classrooms.

Students in the electronically-joined classrooms enter into discussion and ask questions of the teacher by using talkback systems installed in the receiving classrooms.

A member of the social-studies teaching team accompanies student-technicians on a field recording exercise. A remote interview is to be made on a portable videotape recorder using portable cameras.

One portable recording system is recording an assembly program which will be played back through the school's distribution system to home rooms.

Another portable system is recording a student-body address by a visiting astronaut..

Yet another portable system is recording a segment at the fire department for use in a second grade lesson on "community helpers".

Timely recordings are being played back within hours of their production. Recordings having only immediate value are erased while recordings of lasting value are cataloged and sent to the videotape depository.

Teams of teachers from several school districts gather together to cooperatively develop a new course in cybernetics.

A Russian teacher from Parkway District collaborates with a Russian teacher from Affton District in the planning of a series of videotapes illustrating situations in which students can see their new foreign language being used.

A coordinator from Berkeley District meets with his counterparts in Ladue and Bayless Districts to insure that they are not duplicating efforts in their three science series.

A biology teacher manuevers his grog under an overhead television camera to be sure his students get an unobstructed view of exactly where he is about to start his incision.

Thousands of television productions are underway throughout metropolitan St. Louis. Some are before cameras; some are being thought out. Some are simple five minute demonstrations; some are going to be year-long daily television series.

Five well placed television studios simultaneously turn out the more sophisticated productions. A student drama is being recorded in North Circle's studio. In West Circle's studio a teacher is recording lesson number 37 in the new Humanities Course. Down in South Circle's studio a string quartet takes a breather after illustrating how their instruments complement and blend. East Circle is about to begin a special program commemorating Arbor Day. And, the City Circle's studio is being setup for an in-service training program on proper use of standardized test scores.

At four o'clock, the five studios are taken over by the evening shift. These technicians and artists are to videotape 160 programs before they go home.

At midnight two passing teachers joke about the good old days when you didn't teach math at two in the morning. One teacher is going home; the other is just reporting for work.

A junior college student slumps over his control panel and takes a catnap while the maintenance engineer runs his daily check on the studio cameras.

Dawn breaks as a clerk puts the day's timing and routing schedule into the computer. A fellow clerk is filing the night's production record of all the studios in traffic control's master log.

A long distance operator wants to know if the switching center is ready to accept Kansas City's schedule for the day. The stenographer adjusts her head set and wonders what she'll do after the new dataphone link with western Missouri is completed.

A history teacher gives a sigh of relief. The Hagerstown, Maryland studio just released the film footage it shot at Gettysburg for her use in next week's program called "Gettysburg-Before and After".

A French teacher switches off her microphone while she rehearses the next pronunciation exercise for the radio audience. She still remembers the criticism that French-Canadian had given her after her first few tape recordings were aired in Maine.

A math teacher smiles to herself as she realizes those latest reports mean that she has taught more students in the last three semesters than she had during the thirty years before facing the cameras. Her smile turns to a frown as she wonders if this isn't more responsibility than she can bear.

A gavel adjourns the meeting of the cooperating superintendents. They just heard some young fellow predict that in twenty-five years their schools will be joined to the Japanese instructional television network by laser beams bounced off a space platform. Most of the audience believed him. But more than one of the listeners felt that the idea of having a computer on the space platform to make the language instantaneous translation during live programs was just a little much.

SYSTEM SUPPLEMENT #2 (ADMINISTRATIVE DATA HANDLING):

An architect colors with rage as he tells his colleagues how those schools are throwing out humanity when they continue to build schools some blankety blank computer has designed. He concludes the tirade by cursing the day back in 1964 when a junior college district started this whole business (even though they claim the computer saved them millions).

A custodian slips a punched card into a machine in the school office. He still can't figure how central warehousing knows he wants 45 flourescent tubes, 48 inches long, warm white, 100 watts and made by Westinghouse just because he punched two holes in a gray card and stuck the card in a machine. But they hadn't received a wrong order in the four years he'd been sticking cards in the crazy thing. Things always came the next day and no back orders.

In the central data-processing center a magnetic disc moves a fraction of an inch after noting someone down in school 05022 wants 45 number 128995's (otherwise known as model 88 flourescent tubes).

Seventh grade counselor Weber, in Steger Junior High School, dictates the results of his latest interview with that troublesome Matthews boy. He puts the tape recording in the outbasket, confident that tomorrow morning a key punch operator will have noted the coded information and sent it on to storage in the cooperative record center's computer.

A random-access computer, like an octupus playing eight games of ping pong, spits out payroll information, furniture inventory information, class schedule information, student enrollment projections, community census information, report card grading information, and hundreds of other kinds of data to various administrative offices throughout the metropolitan area.

Accounting machines in district central offices chatter incessantly as they print out thousands of bits of information a minute. Clerks tear off the tabulations and printed reports and rush them to various offices.

The superintendent sticks his head into the dispatch room to tell a girl to interrupt her attendance reporting long enough to get those NDEA requests off to Jefferson City before teletype gets tied up with research data he's expecting from Washington, D. C.

He adjusts his tie before the hall mirror before rushing to a Rotary luncheon to project his views on tomorrow's schools.

So that color or whimsy with which the foregoing is written does not overshadow the seriousness, it is well to point out that the multi-purpose methodology described on the last few pages constitutes the plan whose feasibility is being studied by the North Circle Staff.

In one sense there is nothing new (in terms of hardware) in the proposed multi-purpose system. Obviously, there are more pieces of hardware (and more of each piece of hardware) than other planners have suggested on one package. If there is a unique quality found in this logistical system, it is LOCAL CONTROL. It is an access system which provides the student, teacher and administrator with the ability to get WHAT each wants, WHEN each wants it, without being encumbered by faulty access systems or other people making the determination of WHAT he wants or when he wants it.

In searching for a new methodology which holds promise for solving problems outlined earlier, the North Circle staff modified the "scientific approach" somewhat and evolved a "decisions-table system for developing new logistical patterns" (or a matrix for evolving a new methodology). The fanciful projection of what tomorrow's schools may be like is not the product of random, though imaginative, thought. It is the product of the process about to be described. Though still being studied and evolved, the logistical system described on the colored pages took form . . .

1 . . .after problems continued to become more severe in spite of efforts to make current operating procedures work most efficiently.

2 . . .after current operating procedures were analyzed, segmented and studied for their inherent abilities and inabilities.

3 . . .after alternate ways of operating were ennumerated and studied for their inherent abilities and inabilities.

4 . . .after criterion were applied to each alternate to see which operating procedures seemed best, regardless of whether they were now in wide use or not.

5 . . .after comparing the procedures (which seemed to best meet criterion tests) with each other to see if they could form a single, integrated system.

6 . . .after outlining this new logistical pattern and reviewing its theoretical ability to solve the problems which defied solution by the currently used operating procedures..

The project staff believes that, following the above procedures, there will be agreement that a logistical system much like the one projected here is LOGICAL. Steps 1 through 5 listed above are discussed in the following pages; 6 was the colored pages description.

AN ANALYSIS OF PRACTICES CURRENTLY EMPLOYED TO ACCOMPLISH THE JOB OF INSTRUCTIONAL MATERIALS STORAGE AND DISTRIBUTION:

The basic parts of any materials system are:

MATERIALS SCOPE	What kinds of materials are handled?
MATERIALS SOURCES	Are they purchased, rented, locally produced, or a combination of all three?
STORAGE	How are they carried on the shelf? In the natural state, all converted to microfilm or videotape.
CATALOGING	How are they listed and publicized to the using-teacher?
ORDERING.	By what means are they requested for use? Paper and people? Dataphone? Verbal request?
PREPARATION FOR SHIPMENT	How are they handled between the shelf and the delivery system?
DELIVERY	By what means are the materials delivered to the school or teacher? Truck? TV? Customer pickup.
DISPLAY-TO-LEARNER.	How are they presented to the learner? Direct Viewing? Projection? TV screen ? Headphones ?
RETURN TO DEPOSITORY. . . .	How do the materials get back to the storage center? Truck? Walk in? Not returned at all?

IN PROCESSING. . . . . . . .When the items are returned, what handling is required? Inspection? Rewind? Shelving?

Whether the unit is a county AV library or a single school, the above basic system parts exist, no matter how informally.

Perhaps each type of AV material is handled in a different way by the same unit, i.e., all audio materials are converted to audio tape for storage, whereas, all films are stored in their natural states. Perhaps some items are displayed to the learner by projection and others are displayed through headphones.

The different system parts can be outlined to show a profile of the "composite" materials handling system used by . . .

A Classroom System

A School System

A School District System

A County (or other outside-the-district) System.

The analysis chart accompanying this paper (in pocket inside back cover) shows ONE classroom of ONE school of ONE district and the outside-the-district agencies found in St. Louis County.

By conducting a similar charting for each school or classroom, a "PROFILE" of any currently employed system can be visualized.

The chart shows the school's system in relationship with other materials systems with which it must "mesh" in order to form a matched system. In other words, the County AV Department's system for film distribution must be put end-to-end with a school's internal film handling system to form a "matched system", no matter how crude or refined the school's system might be.

After profiling the EXISTING system or systems employed to provide teachers the materials used in teaching, it is then possible to evaluate the . . .

Efficiency

Appropriateness

Obsolescence

. . .of the currently used system or systems.

The familiarity an experienced educator has with all the component operating processes tends to blind that educator to inefficiencies of the overall system. The fore-mentioned analysis chart holds several surprises which come only when the components are thus plotted. Only by charting is it possible to see how many "sub-systems" are being employed in order to supply different kinds of instructional materials to classrooms.

Counting the number of classrooms in St. Louis County (6,744), the number of schools (251), number of districts (28), the area-wide audio visual services (3) . . .and counting the number sub-systems for materials-handling within each of those organizational units(films are handled in one manner, filmstrips another, records still another), there are over 15,000 sub-systems being operated in one county. Each sub-system takes a little money (a lot in some cases), a little storage space, a little human labor, some kind of cataloging, some sort of delivery system, etc.

There is a relativity among books, photos, charts, slides, filmstrips, motion pictures, transpariencies, television lessons, records, tapes, and the three dimensional study materials used in the teaching process. Procurement, storage, cataloging, ordering, delivering, displaying, returning and in-processing ANY of the audio-visual instructional materials generally follows the same pattern. To have isolated sub-systems operated at various levels and in thousands of locations is waste resulting from duplication carried to the thousandth power.

The analysis chart shows that most of the splintering and costly repetition of services occurs at the classroom and school levels. The chart also shows that ultra-expensive operations (film library services, radio, and television) are NOT repeated among school rooms, schools or even districts.

The person who views this analysis chart should ask: "Why are the expensive operations centralized and cooperatively-owned at the county level? And, why are there so many sub-systems found at the school room and school level?" The answers form an axiomatic rule that was never stated, but is practiced because experience has shown it to be true: ECONOMY CAN BE ACHIEVED BY CENTRALIZED STORAGE AND COOPERATIVE USE OF MATERIALS DISTRIBUTED FROM SUCH CENTRAL STORAGE; HOWEVER RANDOM ACCESS CANNOT BE GREAT ENOUGH FROM CENTRAL STORAGE.

THEREFORE, STORAGE AT THE CLASSROOM OR SCHOOL LEVEL IS REQUIRED IF ADEQUATE RANDOM ACCESS IS TO BE ACHIEVED.

This is true even though such access requires buying copies of items by the hundreds, providing files or other storage space everywhere, and having most teachers and supervisors engaged (for a few minutes each day) in operating the miniature materials-distribution systems thus created.

The key words in the above axiom are ECONOMY and ACCESS. Since economy is a natural by-product of centralized materials-handling, is it possible that much more economy could be realized if everything found in classrooms and schools and districts were centrally housed at the county level? Is it possible that the savings thus effected could pay for the electronic system required to give the random access which was provided by (and is the great virtue of) materials-handling at the school and classroom level? What would the nature of such an electronic system have to be? What materials could be shifted to a central depository? What materials could not be transmitted electronically? What are the legal implications of such a move? What are the personnel requirements? What administrative routines would have to change? All are intriguing questions arising from an intriguing concept.

Because of its inherent flexibility for carrying sight and sound messages, it is believed that closed-circuit multi-channel television will be used by every urban-suburban school district for some purpose and at some time. If schools are linked together within a single district for some instructional and administrative purposes, can these district networds be so arranged that they can be joined together to allow the flow of messages between districts? Can such a network be employed outside school time (3:30 p.m. to 8:00 a.m.) for distributing instructional materials from a central depository? Presuming that complex data-processing machinery and a system of inputs-outputs would be necessary to initiate orders, time and route messages, and keep records, could the allied data processing system also be used for cataloging materials and as a storage-retrieval system for many kinds of administrative and educational data? Is such a concept feasible? If not feasible now, will it be feasible in the near future?

It is presumed that electronic transmission of coded material , sound and pictures is entirely possible. If access is sufficient and legibility is sufficient, those materials with which the learner has no overt relationship might be so transmitted. Those materials and devices which the learner must contact physically, in order to understand (training devices and some models having important dimensional relationships), will have to be retained in the classroom.

The analysis chart reveals a very complex and often uncoordinated attempt to supply instructional materials in a manner having no comprehensive growth pattern or planning. Ranging from most informal to most formal arrangement and handling these sub-systems currently employed have a patch-work quilt appearance when viewed from the outer space position supplied by the analysis chart. This range is typified by the classroom teachers' personal picture files on the informal end, and the school librarians' decimal-coded, highly-organized book libraries on the formal end.

In conclusion, the preparation of an analysis chart reveals:

1. What is happening.
2. How many sub-systems exist.
3. The nature of these sub-systems.
4. Where they are located.
5. What procedures they involve.

Preparation of such a chart, using local conditions, is most helpful in gaining an overview of materials-handling in all its ramifications.

Having eliminated the tactile devices and materials (those which must remain in immediate contact with the learner), the rest of the materials can be catagorized by kind of message:

MOTION AND SOUND . . .	films, videotapes and kinescopes (TV made films).
PICTURE ONLY	book pages, photos, charts, diagrams, slides, micro-films, filmstrips, transparencies, maps, drawings, etc.
SOUND ONLY	records and tape recordings.

Evaluation of current practices related to handling these three kinds of messages is accomplished by using a "decisions-table" of alternates.

SURVEY OF ALTERNATE WAYS OF OPERATING

Appendix J is a reprint of a paper given by a member of the research staff on the subject of finding new logistical patterns for materials distribution from a central depository. It was presented at the 1965 convention of the Department of Audio Visual Instruction of the National Education Association in Milwaukee, Wisconsin. (The decisions table of alternates to which it refers is found in the pocket inside back cover.)

The decision table in the pocket of back cover, shows the ALTERNATE ways of doing any one thing. For example: the alternate ways of DELIVER of films might be:

Customer pickup
U. S. Mail
Delivery Truck
Open-Circuit Television
Microwave TV
Bell Cabled TV
2500 Megacycle TV
Pulse modulated TV
High resolution cabled TV

The alternate ways, described in as much detail as necessary, are to be examined to see WHICH way (at this stage in time and under existing conditions) is the:

most efficient
most flexible
most economical
most likely to meet needs

This examination is conducted through the use of "CRITERION TABLES" which are questions to be applied to each alternate. A sample criterion table which might be used to test the alternates found under DELIVERY on the decisions-table is shown in Table #1 on the following page.

CRITERION TABLE FOR DETERMINING WHICH ALTERNATE MODE OF MATERIALS DISTRIBUTION IS MOST EFFICIENT TODAY.

Test each of the alternates against the following decision making factors or criteria:

1. Handling Cost per Unit
2. Processing Time Consumed per Unit
3. Fidelity at Output
4. Message Carrying Capacity per "channel" (or truck, or package, and so forth)
5. Personnel Quality and Quantity Required
6. Capital Outlay (short and long run) per "channel" (or truck or. . .)
7. Reliability of System
8. Likelihood of Obsolescency
9. Maintenance Cost
10. Life of Major Hardware Components
11. Availability of Hardware on Current Market
12. Transmission Time Consumed per Unit
13. "Channels" available

Criteria	1	2	3	4	5	6	7	8	9	10	11	12	13	Total	Alternates
															U. S. Mail
															Customer Pickup
															Open-Circuit TV
															2500 Megacycle TV
															Microwaved TV
															Pulse Modulated cable TV
															Bell Coax Cabled TV
															Other

TABLE #1. Materials Distribution Alternates.

Scoring: Weight positive number one through ten or negative numbers one through ten in each box. Negative shows unfavored position and positive shows a favored position. Number shows degree of favor or disfavor. (Plus one least favorable, plus ten most favorable. Minus one least unfavorable, minus ten most unfavorable).

Such criterion testing, applied by persons knowledgable in the'area, should show WHICH of the alternates is best in each group of alternates.

In effect, the reviewer will have narrowed to one or more methods, the most rewarding way of doing the thing at hand, whether it is storing, delivering, procuring, or so forth.

If the resulting system parts match the parts outlined in the original profile of currently employed system or systems, the reviewer will have simply VERIFIED the appropriateness of the current practices. If, however, WHAT IS (shown on the profile chart) and WHAT SHOULD BE (shown on the reduced decisions-table) varies greatly in parts or in total. MODIFICATION OF PART OR ALL OF THE SYSTEM TO THE OUTLINE SHOWN ON THE DECISION-TABLE PROFILE SHOULD BE CONSIDERED.

This process has involved several steps:

1. DEVELOPMENT OF PROFILE CHART OF CURRENT SYSTEM
2. EXAMINATION OF DECISION TABLE ALTERNATES
3. MAKING SELECTIONS FROM ALTERNATES BY USE OF CRITERION TESTS
4. COMPARING ORIGINAL PROFILE CHART TO DECISIONS-TABLE PROFILE
5. MAKE SPECIFIC PLANS FOR A TIME-TABLE FOR MODIFYING

The last step, the time-table for modifying, should be realistic and developed in light of the local situation. Basically, the time table shows: HOW, IN WHAT AREAS, WITH WHAT SPEED the modification can be made. NOW the system planner is ready for:

1. Money
2. Personnel
3. Facilities
4. Training programs
5. Equipment

In a time of rapidly changing and newly developing technologies, listing the alternate ways of delivering materials and cataloging materials is exceedingly difficult. Individuals who are constantly alert to the changes will be continuously adding to the decision table of alternates. Here are some of the kinds of information daily reaching this research staff, which made formation of an accurate table a process of constant revision:

1. A colleague pointed out that one of the manufacturers of copying machines has managed to make printed facsimiles of still pictures from a television screen at the rate of three prints per second. Some of the facsimiles can be used as masters for further copy making.

2. A salesman ventured that his company will have a new low-cost videotape recorder on the market by the end of the year.

3. A representative of a tape-making firm dropped the hint that engineers are working on a tape head which will use protons and an electron gun as a substitute for oxide particles and finely-gapped heads to increase the band-width in the recording process (a dramatic increase in band-width will allow high speed transmission of videotapes and thereby reduce the number of channels required to pass a given body of information in a given time).

4. A trade journal showed a prototype of a phonograph which can store still pictures and related sound in a totally new way.

5. An announcement from space agency officials revealed a breakthrough in laser communications development.

All these advancements require investigation and shifting from one technology to another as each competing technology is given an appreciable edge by one of the dramatic developments.

The decision table of alternates represents the available choices which seemed worthy of exploitation at the time the table was prepared. To make use of technological developments which require extensive and expensive installation becomes tremendously "chancy". Before installation is complete, there may be basic component parts obsoleted by newer, better, cheaper, or more durable parts.

The Hollywood motion picture industry has passed over many technical improvements in the science of cinematographic recording during its long history. Even though some techniques other than those employed were PROVEN better or more economical, they were ignored (not without full appreciation of the concept) because the current-commitment-versus-the-gains-to-be-realized showed the status quo to be preferable.

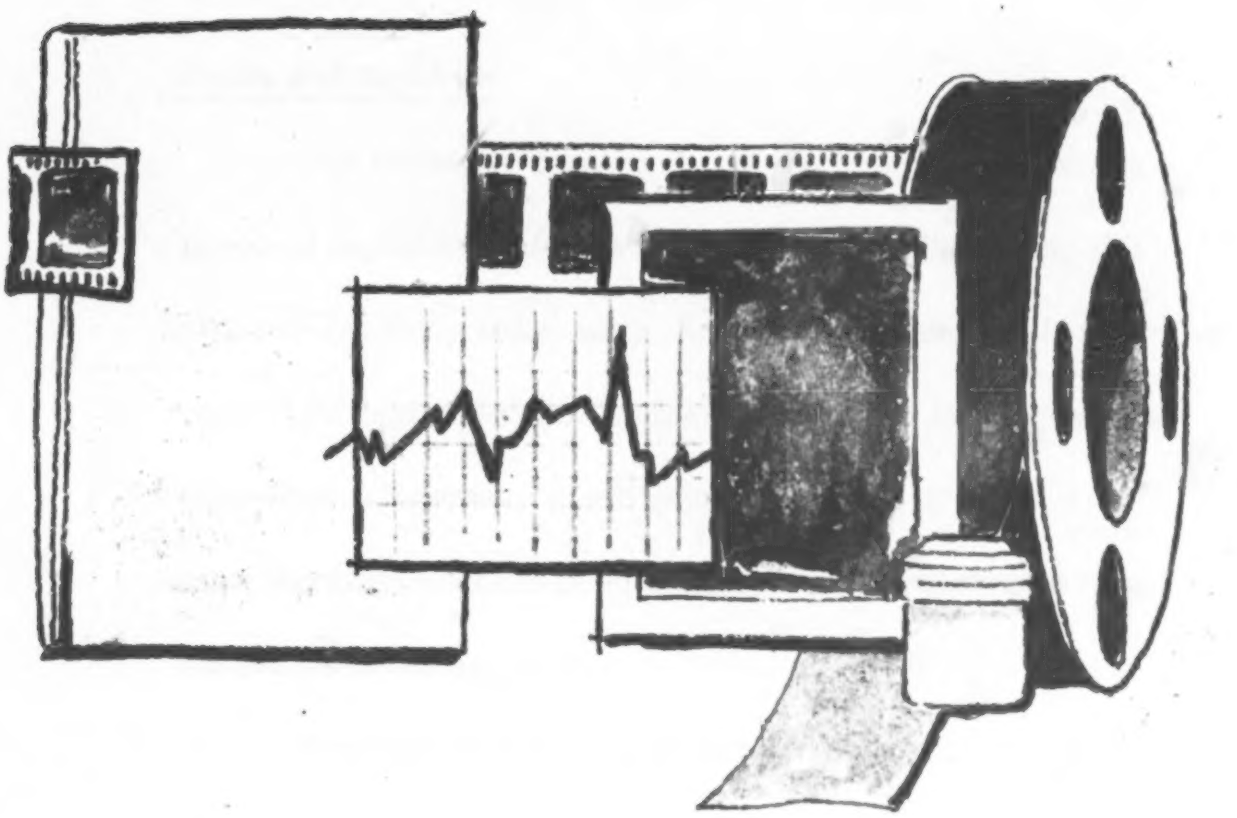
If any new pattern of materials distribution gleaned from the decision table of alternates is to be seriously considered, there must be significantly motivating reasons for changing from current patterns to such a new pattern. Herein lies a basic question to be answered:

Presuming a more efficient administrative routine and technological system is developed, do the gains-to-be-realized carry sufficient weight to overcome the current commitment? Until thorough investigation is completed, this is unknown. This study requires investigation of each and every listing of alternates before criterion tests can be used to choose the components of the new logistical pattern. It is not possible to accept, nor reject, FM radio as a transmitter of instructional messages until enough is known about FM radio to make such a sound judgment. The same is true of all the alternates: 2500 megacycle television, data-phone, wirephoto, cabled television, open-circuit television and disc video recording.

The decision-table maker must therefore be a team of people since no one individual has sufficient knowledge about the frequently unrelated technologies ranging from truck delivery to laser delivery from offset printing to television production. Those avenues of intriguing potential must be pursued until sufficient knowledge is gathered as a basis for deciding the worth of the potential as a system component.

One line of one column in the accompanying decision table of alternates is entitled "2500 megacycle television". Because it exists on the chart (due to its intriguing potential as a high-volume, low-cost message carrier) it must be pursued to its ultimate end. . . even if it might be a dead end. Simultaneous and similar pursuits must be undertaken to know more about the potential roles of multiplexed FM radio, data-phone, random access computer storage and every other line on the decision table.

Other elements of this and future studies must probe deeply into curricular, financial, administrative, educational, technical, and psychological aspects of such a system. At this point, however, priority is placed on developing a system. . .one of infinite flexibility and volume capacity with almost-immediate response if possible. It is a plan to which hardware must be applied. It is an idea which must be translated into action.



SECTION FIVE

SECTION V

IDENTIFICATION OF LEGAL PROBLEMS

Rights and Royalties

The necessary depth probe of the legal aspects of the proposed logistical system has not been conducted during this phase of the study since many facets are concerned with pending copy-right legislation now under consideration in congressional committee. However, identification of the most obvious and most important ones has been attempted. Possible solutions to the problems are suggested.

A school cannot be operated without using the results of someone's creativity. Borrowing from the accumulated artifacts, recordings and experiences of mankind as a whole, and from all accumulated time seems to be quite acceptable to every one concerned. Only when borrowing a specific artifact, a recording or an experience of a specific man (or his agent), living or dead, does one get into trouble. This confirms the tongue in cheek truism: Borrowing from many books is research; borrowing from one is plagiarism.

Public education cannot avoid conflict between the interests of the learner and the interests and rights of the author or publisher of a work. Segments of laws permitting "fair use" and other restrictive use of someone's creativity only beg the question. Although most of the subject matter used in the teaching process, and materials which assist in the teaching of subject matter, was created for purposes other than instruction, many people make a living by creating information, experiences, and materials for the sole purpose of selling their creative wares to education.

Current laws as well as those being proposed by educators and publishers ALL have features which would prevent the full implementation of the proposed logistical system. If the most advantageous law for publishers and authors were passed, it would seriously hamper the process of education. If the most advantageous law for educators were passed, it would mean the end of many small publishing houses and many larger ones would have little motivation to stay in the business of supplying materials for education. The unrestricted use of materials in the newly possible ways suggested in this report could have the effect of winning a battle and losing the war...unless reasonable profit is found for suppliers of materials.

This suggests that the nature of the laws surrounding transmission, copying and using materials can be most important. As copyright laws now stand, the system could not be implemented without consent of many parties to forego their rights. And any changes in the law can be detrimental, in the long run, to educational use of the system whether the changes favored freer or tighter restrictive use.

Though some legal base, other than that used at present, must be found, the laws constitute a side issue to the real problem. The legal problems will be large or small according to how well we solve the marketing-relationship problem.

Present pricing, profit, operating patterns and general business procedures of publishers are based on the way the market functions. This is also true of royalty pricing. The efficiency with which educators use the number of items they buy determines how many copies they will buy (for coverage, replacement and repair). This, in turn, dictates the production and marketing procedures a company will use. This, in turn, dictates the profit and pricing policies the company will use. As long as a profit can be made from filling a need, companies will fill the need in order to make that profit. Some companies artificially create the need (expand the market and profit) by aggressive saleswork. At any rate, today's marketing relationship between educators and suppliers of instructional materials was based on the current logistical systems.

Stated in other terms, education's inefficient logistical system causes pricing and profit to be what they are. Any major deviation from current logistical systems will upset present marketing and cause publishers and authors to appeal to the statute books.

It would be the greatest of errors for laws to be the tool for thwarting efficient growth and changes in education. Yet, any change which hurts the profit level of a materials-supplier is bound to cause this unjust use of justice.

Must education continue to employ inefficient systems which require slow service, multiple-copy buying, and continuous damage-replacement cycles? If there are better ways to teach and to use public funds must we ignore them?

If the new logistical system is right, it should be implemented. If implementation causes a decline in sales and profits, a new marketing relationship should be established. If a new relationship which is profitable to both the publishers and educators is found, the ends of both will be served. If the ends of both are served, there will be no conflict which will drive parties to the protection of the letter of the law. The spirit of the law, which might be interpreted as the definition and safeguarding of the rights of those who create and fairly use the product of creativity, will then be served.

If the hypothetical system (described earlier) were to be implemented, anything short of a new marketing relationship based on use of electronic transmission and copying of messages, will yield bitter and useless battling. This is one war that is needless and can be avoided.

Though unpopular with those who are deeply committed to the status quo, most far-sighted businessmen seem willing to investigate the possibility of such a new marketing relationship. The research staff of this project has met a wide range of support and criticism regarding this topic.

Since the problem of marketing and the law is of education-wide and industry-wide importance, it would be presumptuous of the North Circle project staff to do more than define the problem. The solutions involve those who make office copy machines, television equipment, recording equipment, materials, and other supporting facilities.

The National Education Association or any other agency which treats use of copyrighted material and otherwise restricted material as purely a legal question would do well to re-examine its position in light of the above.

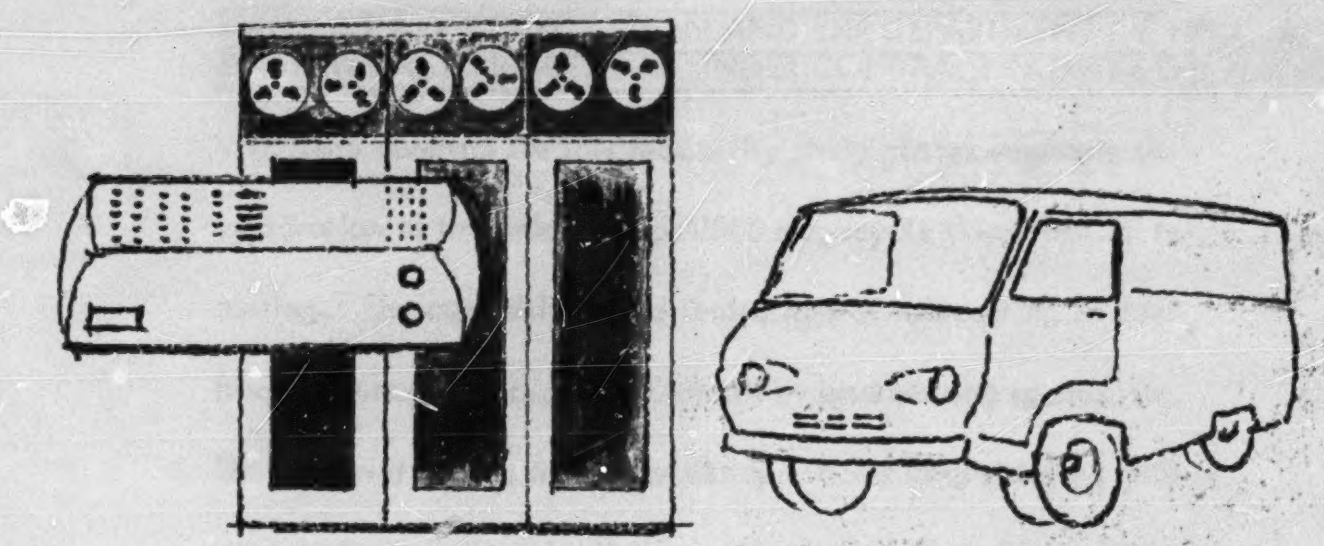
Teacher Rights

Much thought has been given by the research staff to fair exploitation and fair return to those teachers who personally contribute to wide spread and repeated use of their unique talents. At the moment television teachers and writers lack the organization to present a definite expression of their positions. By contrast the publishers and commercial writers have fairly rigid and uniform rules protected by laws.

At this time the staff does not wish to report the extent of the problem or give rank priority to suggested solutions. Only a few comments are apropos:

1. It would be unfortunate if teachers who write or teach for recorded television were to become militant to the point that their "rights" overshadow or negate the purposes of their creativity.
2. It would be unfortunate if school districts pervert a method of efficient staff utilization into a method for unfair exploitation.
3. It would be most fortunate if a universal system could be developed which is profitable and fair to both the creators and users of school staff-made material.

This intraschool problem is related to the education-publisher problem.



SECTION SIX

SECTION VI

RELATIONSHIP OF THE FOREGOING PORTIONS OF THIS REPORT TO THE STUDY CONTRACTED BETWEEN THE COOPERATING SCHOOLS A-V CORPORATION AND THE DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE UNDER CONTRACT NUMBER OE-4-16-024:

The contract for this feasibility study places emphasis on exploration of the unknowns of 2500 megacycle fixed-station telecasting. The capabilities and limitations of telecasting in this frequency range were largely known by engineering specialists. The behavior of this signal frequency follows long standing microwave and omni-directional telecasting principles. Most vital of the technical explorations made by this study were in the same-channel and co-channel interference problems which may occur when an urban area becomes saturated with 2500 megacycle stations placed in close proximity with one another. Reporting on test findings occurs later in this report.

The basic problem which prompts investigation of ways to achieve close proximity of identical television signals is the anticipated need for more than 31 simultaneous transmissions by television (31 being the number of channels in the recently allocated 2500 megacycle grouping). It seems absurd, at first glance, to believe that 31 instructional television channels in a given geographic location is not enough (considering that one open-circuit channel is all that is available in St. Louis and other urban areas). However, testimony before the Federal Communications Commission in January 1965 on the occasion of a conference of educators, commercial developers and federal employees showed some problems. The essence of this meeting was:

1. Thirty-one channels in a given area must be shared by those entitled to use them i.e., public school districts, colleges, universities, parochial systems and others qualifying for application and use.

2. Rules allowing a single school system-applicant to reserve five of the thirty-one channels while implementing only one, leads one to believe that the first six applicants in a given area could consume the available spectrum allotted. Presumably, this could be six school districts in an urban area of 30 or more districts.

3. Without changes in the rules concerning reservation and possession of multiple channels by a school system-applicant or without complex mediation and ruling processes to sort out worthiness of potential rival systems, a high degree of self-control and cooperative planning will have to exist in large urban areas. Hopefully, potential users of the 2500 megacycle channels will develop and abide by a channel allocation and transmitter placement plan. Such an eventuality is unlikely without a level of patience, wisdom and cooperation which is rarely exhibited among school systems.

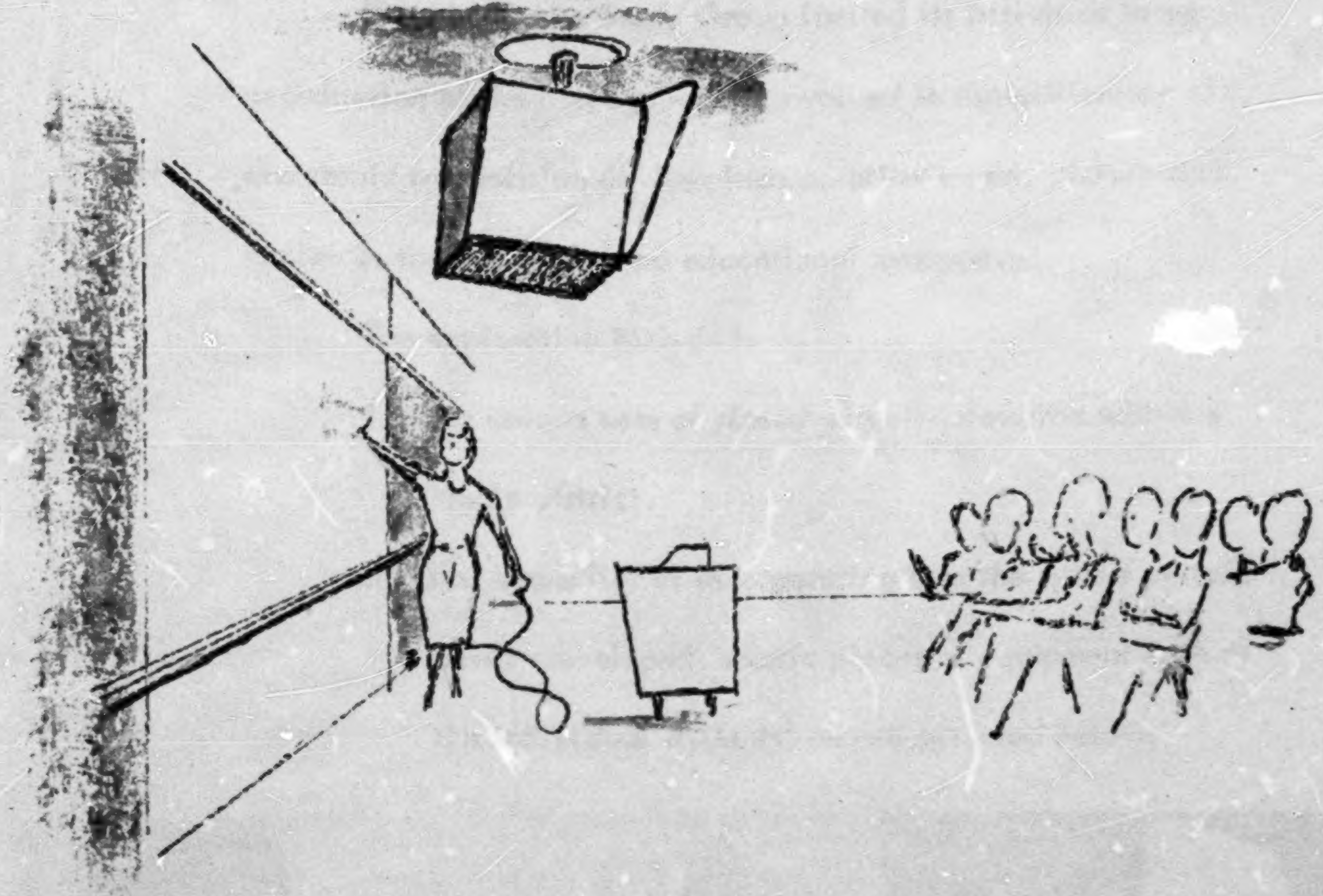
Aside from the anticipated drain on channels reflected in the conference conversations, instructional materials distributors who aspire to use the 2500 megacycle spectrum have need for more channels than are currently available.

The problems attributed to open-circuit television due to limited spectrum (referred to in an earlier section of this report) would also apply to 2500 megacycle fixed-station service even though this might be 1/31 as much a problem in 2500 megacycle telecasting.

As long as there are more messages to be carried than there is carrying space, there can be no reliance on television above as a basic instructional message distribution. Supplemental methods (currently employed methods) will have to be retained to the extent that messages exceed carrying capacity in spite of any defects in current systems which offend the logisticians' sense of efficiency. There are more than 17 messages to be carried a day (the usual program output of single channel broadcasting). There are more than 31 x 17 messages a day to be carried (the probable output during school hours if all 31 channels were simultaneously implemented). There are thousands upon thousands of messages to be carried per day. The limitations of the message carrying system must not dictate what experiences are best for the learner or when they should be experienced.

It is not necessary to confine the search to the 2500 megacycle band for such a high number of channels. But, since it might offer the best low-cost way of satisfying the criterion tests, and perhaps MAY provide the needed 150 channels, 2500 megacycle television warranted deep probing. It seemingly has the ability to provide a high number of channels in a given geographic area.

The next section reports the experiments conducted and conclusions drawn with regard to using 2500 megacycle television in a manner which reduces pending competition for relatively scarce spectrum space.



SECTION SEVEN

SECTION VI:

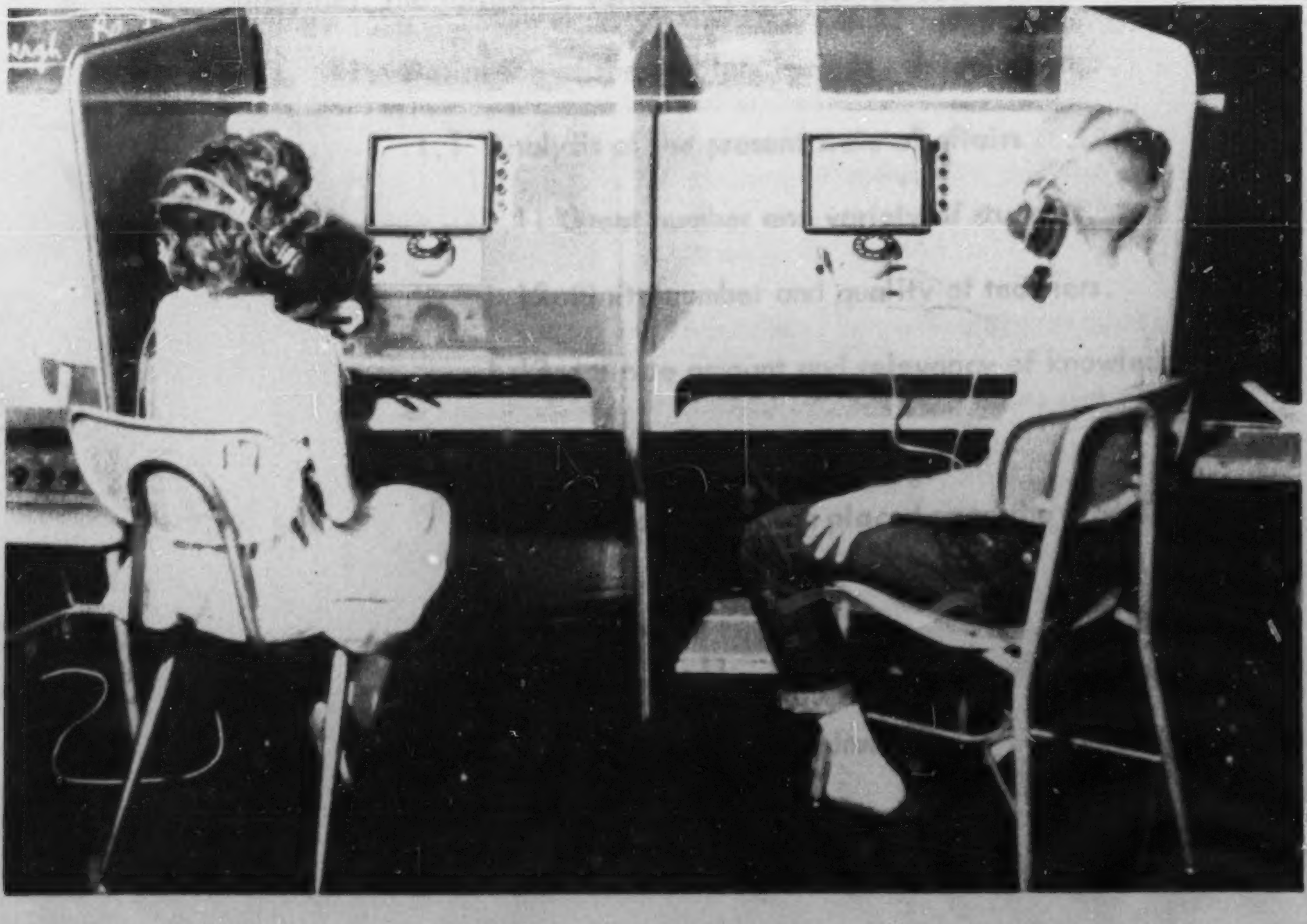
INVESTIGATION OF MEDIA USE

Statement of Purpose

The Media Use Study Group limited its activities to an examination of the basic problems involved in the utilization of electronic transmission devices incorporating sound, picture and motion as the carriers of the educational message.

The exploration included:

1. **The unique uses of closed-circuit television within a single district.**
2. **The feasibility of incorporating into the system certain newly-developed, exotic pieces of equipment such as the individual students' carrels pictured below.**



3 The possible uses of video tape recorders as storage and retrieval devices.

4. The potential linkage to commercial and open-circuit educational stations as program sources.

5. The linkage of contiguous school districts on a shared-program basis.

6. The transmission of the present resources of the St. Louis County Audio-Visual Department at appropriate times and places to each school.

Background of the Task

Any preliminary approach to the utilization of media depends upon the definition of the problem to be solved. As a guide to planning the following variables were considered.

1. Definition of the problem included the following:
    1.1 Analysis of the present state of affairs
        1.11 Great number and variety of students.
        1.12 Finite number and quality of teachers.
        1.13 Infinite amount and relevancy of knowledge being created.
        1.14 Societal demands placed upon the school.
            1.11 Individual pace of learning of children

1.111 Culturally deprived. socially deprived, economically deprived =educationally deprived. Aim: powerful school environment plus pre-school experience plus parental education.

1.112 "Average"--review, reinforcement.

1.113 Gifted: Expansion and depth.

1.12 The continuous motivation of students.

1.12 Finite number and capability of teachers.

1.121 Teaching load

1.122 Relation to structure of knowledge

1.123 In-service training needed in this area

1.13 Amount and relevancy of knowledge

1.131 Structure of knowledge and its relevance for method

1.132 Evaluation, including higher mental processes and affective behavior

1.133 In-service training needed in this area

2. Decision making process involves

2.1 What is to be taught and transmitted

2.11 Behaviors desired

2.12 Content utilized

2.13 Level at which the content is aimed

2.2 For whom it is to be taught and transmitted

  2.21 Pre-school children

  2.22 School population

  2.23 Parental education

  2.24 Teachers

  2.25 Principals

2.3 By whom it is to be taught and transmitted

  2.31 Classroom teacher

  2.32 Specialists in content and child behavior

  2.33 Others

2.4 For what purpose is it to be taught and transmitted

3. Given tentative answers to these problems, the next task of the committee was to develop an organizational structure through which these background considerations and other problems related to electronic transmission of curricular materials could be explored.

Organizational Structure

1. The superintendents of the Berkeley, Hazelwood, Jennings, Kinloch, Riverview Gardens, and Ferguson-Florissant Districts met to discuss problems of a general nature. They recommended the establishment of a Committee consisting of 3 or 4 members from each district. Membership of this committee is shown on page iii.

2 The Committee was charged with a two-fold responsibility:

   2.1 To initiate and stimulate means by which teachers within each school building could become involved with studying the problem.

   2.2 To develop ways and means of inter-district cooperation in the analysis and development of curricular materials.

3. The next step was to develop a smaller working group consisting of one representative from each school to carry on the discussions and proceed with the planning and development of the curricular phase of the Project. This sub-committee, called the Media Use Study Group, consisting of Mrs. Dillinger, Mr. Herweck, Mr. Olive, Mr. Chickering and Mr. Morris began work on problems of immediate concern.

The Media Use Committee at Work

In order to facilitate the work of the Study Group, a series of questions was developed which served as a basis for deliberations within each school district. Among these questions were:

1. What are some of the factors inhibiting the classroom teacher from doing a more effective job of instruction than he/she may be doing at the present time?

2. Can any of these problems be rendered less perplexing and capable of solution by a more creative utilization of electronic media? (television in all its forms, video tape recording, et. al.)

3. If so, does this call for the development of new curriculum materials or does this mean that we must seek better ways to retrieve existing curriculum materials for use in individual classrooms, or both?

4. If any of the felt needs (1) can be solved or, at least, partially resolved by the creative use of electronic media (2) and this implies the development of new curriculum materials (3).

   4.1 Do we, within each individual school or within the schools comprising each district, have the human resources to develop these materials?

   4.2 What prior problems will have to be resolved before we can utilize these human resources?

   4.3 What are the peculiar strengths in human resources and curriculum areas that presently exist:

      4.31 . . .within an individual school that can be developed to be of benefit to other teachers and students within that school?

      4.32 . . .within an individual school that can be developed to be of benefit to other teachers and students within the district?

4.33 . . .within the district that can be developed to be of benefit to other teachers and students within the North Circle Project?

5. What kind of an organizational structure can be established within each school or within any district to carry forward such a project as envisioned by answers to the above questions?

Preliminary Inventory of Possible Uses of Television

Each district approached the problem in its own way and the following summary represents ideas and suggestions gleaned from their reports. It is not intended to be a complete inventory, but merely an indication of some of the ways television may be used other than as a talking textbook.

1. To provide supplemental curricular materials not readily available within each school.

   1.1 To develop a foreign language program on the elementary level.

   1.2 Development of new and experimental courses on the secondary level. Examples of courses presently being considered included:

      1.11 Behavioral science course, selecting content from several disciplines.

      1.12 Humanities courses, using artifacts not readily available in the classroom.

1.13 International relations, using teachers from two or more districts.

1.14 Economics, as a climax to K-12 topical approach

1.15 Advanced science, video taped by college instructors.

1.16 Communism and other controversial areas in which teachers feel insecure

1.3 Presentation of specialists at work

1.31 Artists for art classes

1.32 Craftsmen for industrial arts, home economics, et. al.

1.33 Scientists at work in various fields

1.34 Governmental officials for social studies

1.4 Presentation of excellent departmental productions in an individual school to other districts.

1.41 Choral groups music, drama debate

1.42 Science fair exhibits

2. To reach every student in a given school or district without bringing them all together physically

2.1 Administration of tests

2.2 Vocational information dissemination

2.3 Orientation progress

2.4 Home room activities

2.6 Materials presented by specialists. Examples are:

    2.61 Social Hygienics - nurse or doctor

    2.62 Library acquisitions and other pertinent data

2.7 Administrative necessities.

2.8 Development of news programs of current interest

2.9 Team teaching projects involving teachers from two or more districts

3. To cooperatively develop "documentaries" of field trips in areas difficult to transport large number of students, examples:

    3.1 Art Museum. Jefferson Memorial. and so forth

    3.2 Merchant's Exchange, Computer Centers

    3.3 Architectural and house tours of city

4. To utilize in-service programs for teachers

    4.1 District-wide faculty meetings

    4.2 Sharing of specialists in one school with all, as

        4:1 District-wide faculty meetings

        4.2 Sharing of specialists in one school with all, as

            4.11 Outside consultants

            4.12 Visiting dignitaries

            4.13 Development of skill in "new" curricular areas as math, science, foreign language

    4.3 Demonstration and analysis of excellent teaching techniques

4 4 Building concepts as to "why" things are taught as well as "what" and "how" things are taught.

Since time was of the essence, attention was focused on testing, rather than proving, certain selected hypotheses forming the electronic chasm. The first of these concerned identification of problems which teachers considered significant in the teaching-learning process.

A questionnaire was circulated which grouped problem-factors into three categories: 1. Physical - those related to space-time etc.; 2. Personal - those related to the teacher; 3. and those that are pupil centered:

Five hundred teachers were asked to check problem-factors on the questionnaires indicating either: 1. a real problem; 2 somewhat of a problem; or 3. no problem. About 80% responded. From the tabulated responses it can be assumed:

TABLE #3
Teacher Questionnaire

1. Teachers regard pupil factors as the greatest problem, with individual differences (due to ability) as the greatest within this category. Next in line is motivation, closely followed by continuing interest. Last, but still significant, is the problem of varied pupil backgrounds. Tabulated, the results were as follows:

	Real problem	Somewhat	Total
A. Individual differences	91	264	355
B. Motivation	56	217	273
C. Continuing interest	46	215	225
D. Varied background	52	173	225

2. The physical factors were next in importance as listed by teachers. There were some noticeable differences here depending on level (elementary, junior high or high school). with time being the greatest problem-factor with elementary teachers. space with high school teachers. and teacher-pupil ratio with junior high teachers. Naturally these factors would vary according to the individual school. Tabulated, the results (includes both "real problems" and "somewhat of a problem") were as follows:

Item	Elem.	J.H.	S.H.	Total
A. Time	178	58	42	278
B. P-T Ratio	121	90	43	254
C. Space	111	58	59	228
D. Material	90	74	37	201
E. Equipment	70	56	41	167

An effort was made to determine the nature of the space problem (large group, small group, individual) but the number who so identified the problem was too small to consider statistically.

3. The area of teacher centered factors was the one in which teachers identified fewest "real problems" although a number checked these items as "somewhat of a problem". Tabulated, the figures were as follows:

Item	Real	Somewhat	Total
A. In-service help	36	89	125
B. Ability	15	107	122
C. Methods	4	107	111
D. Course work	23	82	105
E. Background	11	68	79

In identifying subject areas where preparation or ability was a problem, the following are most prominent: science, music, and art. Mentioned a few times each were: reading, phonics, social studies, and language arts. Most of these mentions were by elementary teachers.

Conclusions that may be drawn from the above are self evident. The following questions now reamined:

Can the electronic media help solve the problem of individualizing instruction so that it meets the needs of pupils of varying abilities?

Can the electronic media help solve the problem of motivating and sustaining interest in a learning situation?

Can the electronic media help fill the "gaps" in the varied backgrounds of pupils sharing a common learning experience?

Can the electronic media relieve teachers from some of the pressures brought on by not having sufficient time for planning?

Can the electronic media help solve the problem of inadequate space for specific types of learning and teaching?

Can the electronic media relieve the ratio of pupils to teacher?

Can the electronic media relieve the materials and/or equipment problems?

Can the electronic media provide teachers (and incidentally pupils) with richer backgrounds, greater knowledge of content, greater skill in methodology etc. which will result in a better experience?

In an attempt to capitalize on the uniqueness of the electronic media in solving the problems caused by individual differences and motivation, it was necessary also to consider its disadvantages and search for ways to minimize these limiting factors.

The basic principles involved in electronic teaching-learning seemed to be the same as those found in other media, namely:

Drive (motivation) – the student must want something

Cue (stimulus) – he must notice something

Response (participation) – he must do something

Reward (reinforcement) – he must get something he wants.[1]

Involvement or interaction (response or participation) has long been considered a point of vulnerability in educational television. The standard techniques advocated to overcome this criticism were now considered. They included:

1. Helping the learner identify with others who are on the program.
2. Involving the learner in planning and evaluating the program.

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[1] These factors are illustrated in a film by Miller, N.E. and Hart, G. "Motivation In Learning", 15 min., sound, black and white. Psychological Cinema Register, Penn State, Univ. Park, Pa.

3. Stimulating the learner to do something when the program is completed i.e. practice skill.

4. Giving the learner a part on the program occasionally--on camera.

Mount Pleasant Interaction Experiment

Since the learner was to be considered a rational participant rather than a passive receptor of impressions, a new dimension was added to the experiment at the Mount Pleasant school.

While a former symphony member at the North Circle Studio demonstrated the playing of a musical instrument for sixth graders, the students were encouraged to ask questions via a conference phone using a regular telephone circuit as the audio carrier from the classroom three miles distant.

Classroom reaction was then observed of the "live" version and later compared to classroom reaction with another sixth grade class to the "taped" version in an attempt to determine on a gross scale what if any, difference might be noted regarding student involvement and interaction.

Observations

Generalizations may be dangerous because of the lack of carefully controlled conditions under which the observations were made. However, it may be stated that noticeably more involvement was seen and greater motivation resulted from the "live" program than from the "taped" version (in which the students were not permitted to question the artist). This would tend to support the assumption that:

1. Interaction is more important in learning situations where perceptual, affective and cognitive learnings are desired.

2. Learning situations where the desired outcomes are such that they can be learned by rote methods should not be given high priority on the electronic media.

3. More "teachable moments" occured in the "live" program than in the "taped" version. Since of the three elements involved in this readiness (sufficient maturation, mastery of pre-requisite learnings, and motivation) it was possible to vary only the last, it can be assumed that the greater number of teachable moments resulted from this control.

4. The electronic media seemed to be most effective when it was used to create disequilibrium rather than complacency, to raise questions in an open end manner, and present alternate courses of action.

Immediacy of Delivery and Its Effect on Continuing Motivation

In an attempt to further probe the area of continuing motivation, an experiment was structured which included:

1. The use of individual carrels which permitted a student to exercise the process of self-selection of material from three television sources (via a telephone-type dial system) and 99 audio-only via a previously programed tape recorder.

2. Electronic distribution of material from the County Audio-Visual Department was achieved via the 2500 megacycle frequency in response to direct phone ordering. Film and

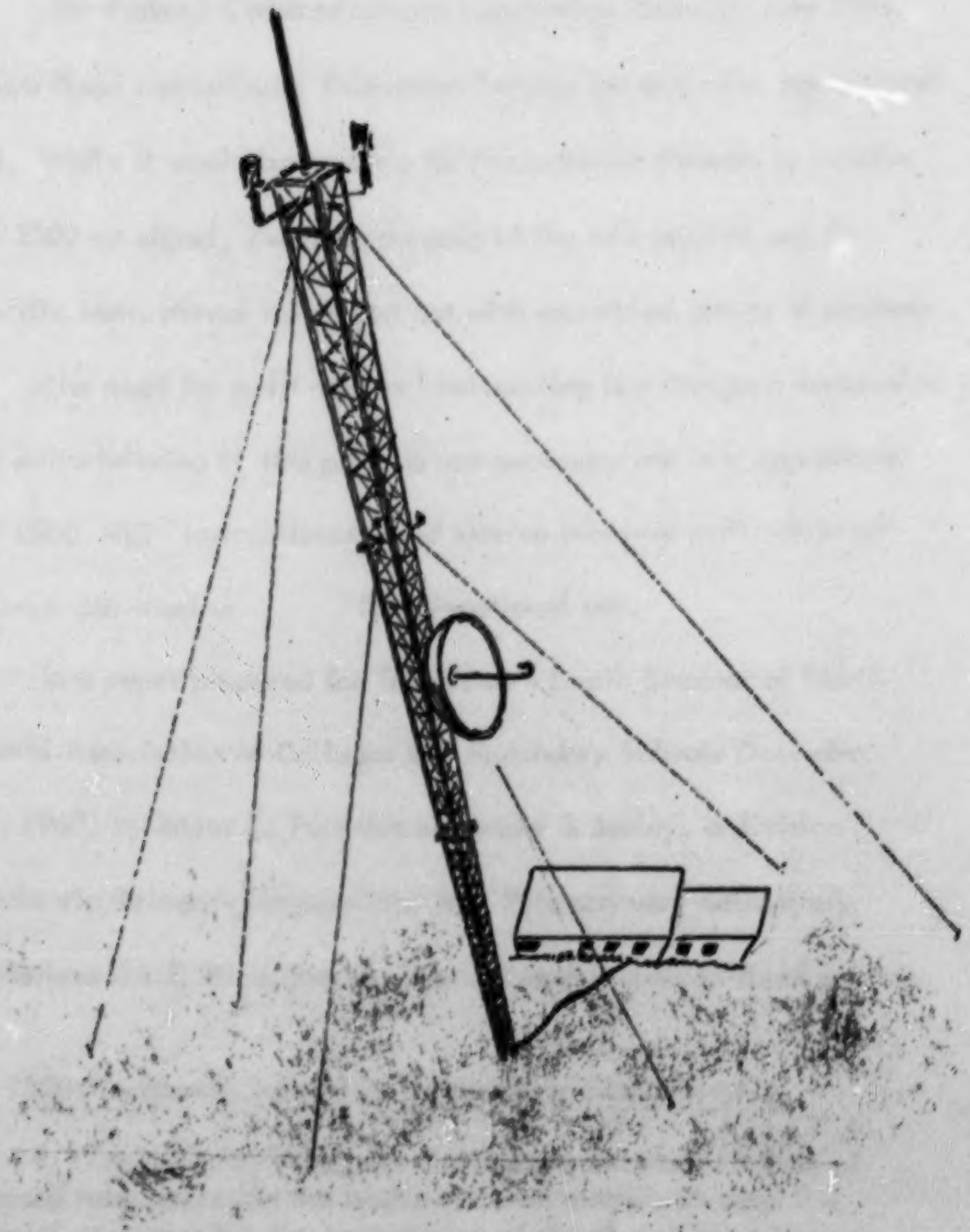
audio-only material was transmitted on a daily schedule during the testing period and observed both live and held on a video tape recorder. A typical daily log of this operation is found in Appendix H.

Conclusions

Again it must be stressed that scientifically controlled conditions did not exist due primarily to the limited time during which these observations took place. However, the following notations should serve as a springboard for further investigation:

1. The use of film increased almost 300% and audio requests almost doubled the delivery of those materials received during a similar period last year. Whether or not this would continue is open to question.
2. Electronic delivery of film which was not taped did not permit repeat and rerun of certain sequences, thus cutting down on pupil-teacher interaction. The absence of this control seemed anxiety-producing to some pupils who had been accustomed to teacher involvement at the elementary level. With the added use of in-school recorders this problem would have been eliminated.
3. Over-achievers (previously identified by the classroom teachers) re-acted most favorably because this process of self-selection permitted them to use their established patterns for learning.
4. Students identified as having reading problems seemed to make greater use of this method of viewing as a convenient vehicle of learning.
5. There was little evidence to indicate that students in the control groups developed a more favorable attitude toward school in general as a result of being allowed to use self-selection or immediate delivery techniques. Furthermore, the reaction of their peer groups produced no noticeable halo effect.

Because of the interest sparked by this investigation the questions involving physical factors and teacher-centered factors (neither of which have been examined to date) should be considered in a continuing study.



SECTION EIGHT

The Federal Communications Commission issued, in July 1963, a new fixed instructional Television Service for exclusive educational use. While it would be possible for home-bound students to receive the 2500 mc signal, the main purpose of the new service was for specific instructional television use with assembled groups of students.

The need for multi-channel telecasting is a foregone conclusion and editorializing at this point is not necessary nor is it approriate. The 2500 MC instructional fixed service provides multi-channel message distribution for educational use.

In a paper prepared for Television I Depth Seminar of North Central Association of Colleges and Secondary Schools December 5-8, 1963, by Roger E. Peterson of Jansky & Bailey, a division of Atlantic Research Corporation, Mr. Peterson very adequately summarizes the 2500 megacycle instructional television fixed service:

The 2500 Megacycle Instructional Television Fixed Service

"1. On July 25, 1962, the Commission adopted a notice of proposed rule making in the above-entitled matter, to meet the needs of educators for the transmission of visual and aural instructional material to students enrolled in courses of formal instruction. While it would be possible to receive the transmissions of the stations which would be authorized under the proposed rules in homes or other individual receiving locations, the most important function of the new service would be to reach groups of students assembled in classrooms or other similar places for the specific purpose of using the instructional material so transmitted. Therefore, the transmissions from stations licensed in this service would be directed primarily to specific locations selected in advance by the licensee and equipped with suitable receivers by the licensee. While it may be technically feasible to conduct the operation on broadcast channels the success of the operation does not require the use of broadcast channels.

"2. As a matter of fact, there are certain advantages in conducting this type of operation on non-broadcast channels. Most instructional TV systems will require more than one channel so that teaching material in several subjects may be transmitted simultaneously. Multichannel assignments which are not available in most places on broadcast channels can be made in non-broadcast bands. By avoiding this unnecessary use of educational broadcast channels they are left available for the transmission of cultural and educational programs designed for reception by the general public on receivers located in individual homes. Transmitter power in many cases can be used more efficiently because it may be concentrated in the directions of the selected receiving locations. Broadcasting is inherently wasteful of power because it must cover a wide area whether or not its signals are actually used by everyone in the area and it must provide a strong signal so that average home receiving installations, which are not the most efficient, will obtain reception. The ability to use power efficiently in a non-broadcast type of operation will permit the use of lower powered transmitters which cost less to buy and operate. While we have no specific data on the cost of receivers-converters for use in these bands, it is quite likely that they will cost more than similar UHF broadcast converters, perhaps twice as much. This may offset the saving in transmitter costs. However, when these receiver-converters are manufactured in quantity, the cost is likely to come down. Use of non-broadcast channels also provides a degree of privacy to the system because the average home will not be equipped with the special receiving apparatus needed to receive signals outside of regular TV broadcast bands and classification of the service brings it under the protection of Section 605 of the Communications Act which is concerned with the unauthorized use of non-broadcast communications. The greater availability of channels in non-broadcast bands will provide for more independent systems wherein the selection and scheduling of instructional material can be tailored to the needs of the licensee."

Despite the obvious advantages of this new fixed instructional television service, the multi-channel capability is still limited when the number of messages that need to be distributed is projected. This report will deal with the possible arrangement of transmitter locations which would allow for multiplication of channel groupings by the Federal Communications Commission. Specific 2500 megacycle recommendations are discussed in this engineering section.

Current Use of 2500 Megacycle

Since the inception of the fixed instructional television service, there are many educational institutions which have formulated plans to use this medium of television signal distribution. (Appendix F).

The appended listing of users and proposed users is somewhat deceiving in that it would lead to belief that comprehensive answers are available concerning this medium of distribution. It would be well to keep in mind that up until this investigation there has not been a comprehensive study made of 2500 megacycle television which answers all of the following questions:

1. Is it possible to multiply channels on the 2500 megacycle band by using some form of antenna polarization technique?
2. What effect do extreme weather conditions have on 2500 megacycle signal propagation?
3. To what degree is it necessary to consider the manmade interference factors (radar, airplanes, buildings) when planning a 2500 megacycle program on a metropolitan wide basis?
4. What effect does the topography have on 2500 megacycle signal propagation?
5. What is the reliability factor of 2500 megacycle signal propagation over an extended period of time?

It is true that most 2500 megacycle equipment manufacturers will give speculative answers to the above questions. However, until the finalizing of this report, there has not been valid research giving specific information pertinent to the above areas. The Engineering

Section of this project attempts to bring forth some criteria which should prove useful in making valid judgments on the acceptance or rejection of this medium of television distribution.

Federal Communications Commission Form 330P

The Federal Communications Commission requires that any applicant wishing to apply for a 2500 megacycle license must file form 330P, which is commonly known as a preliminary application. This form requests information from the applicant in the following areas:

1. Legal
2. Financial
3. Transmitter location
4. Reception points
5. Technical information on the equipment to be used
6. Maps and elevation drawings of each site
7. Proposed program material

Federal Communications Commission Construction Permit

The Federal Communications Commission requires that the initial application must be on file 30 days before a permit can be granted. This provides sufficient time for the Commission to hear any objections which other parties might raise. Actual construction must begin within 60 days after the issuance of a construction permit. This period might be extended if good cause is shown. However, the Federal Communications Commission, by imposing the 60 day contruction permit regulation, guards against unnecessarily tying up channels which might otherwise be utilized.

2500 Megacycle Signal Characteristics

The frequency level of 2500 megacycle lies far above the general range of commercial television stations. It actually falls in that section of the television spectrum reserved for microwave transmissions. The 2500 megacycle signal very closely resembles true microwave in that true microwave must travel in a straight line without any obstructions in the signal path. Terrain, building location, foliage and other man-made obstructions are all factors which must be taken into consideration when transmitting a signal at 2500 megacycle.

The development of profile radials of existing terrain, such as those contained in appendix E, is one of the first steps in determining whether or not 2500 megacycle television signal distribution will satisfy the requirements of any given locale.

Specific data contained in the technical section of this report deals at length with reception of the 2500 megacycle signal. It should be noted that the essential elements required for satisfactory signal distribution are:

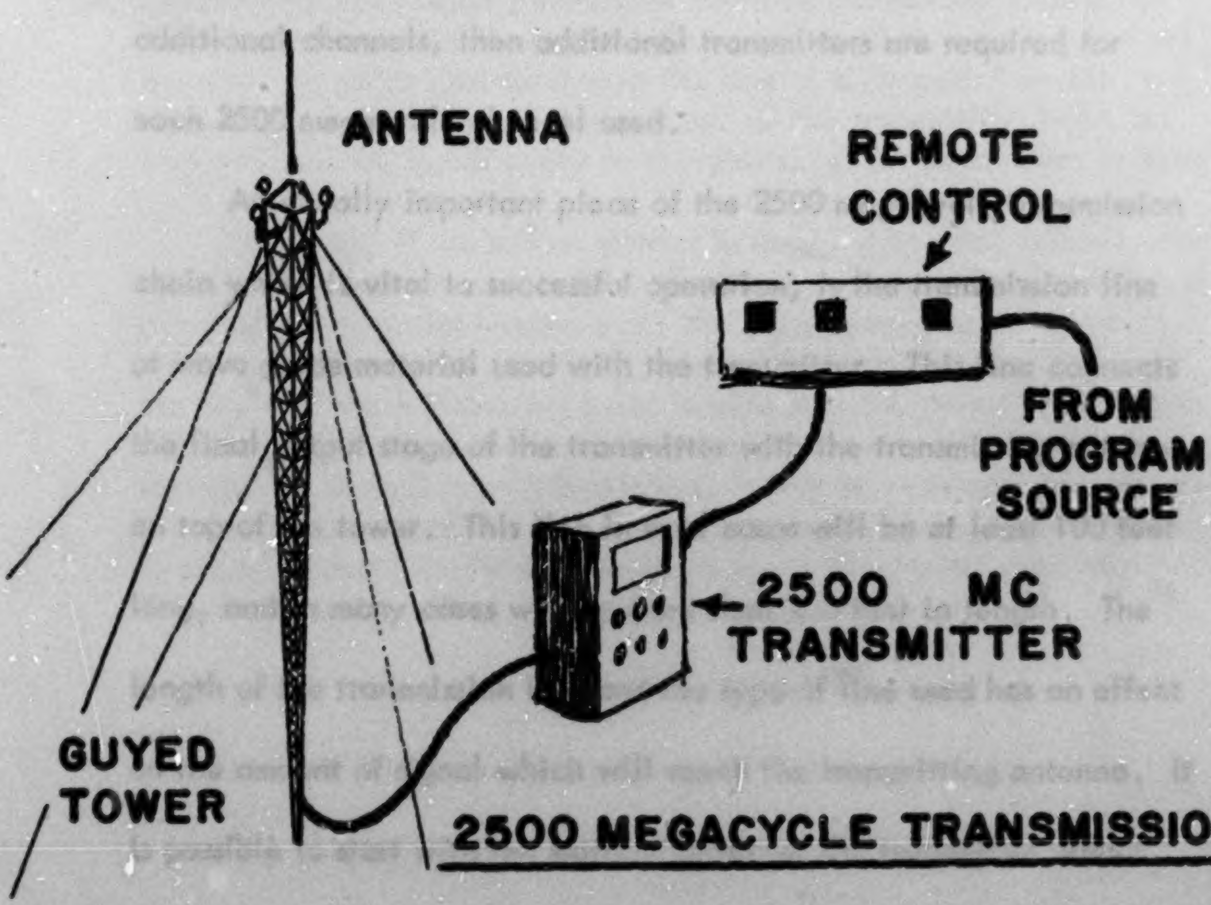
1. Approximate transmitter location
2. Approximate transmitter power at the transmitting antenna
3. Approximate transmitter tower height
4. Approximate receiving antenna gain
5. Transmitting antenna technique used (vertical or horizontal polarization).

It should also be noted that certain conditions may exist in different locations which would prevent adequate tower height being achieved. Inherent factors such as local zoning laws, FAA regulations and so forth could be deterents. In St. Louis County, for example, local zoning laws direct that any tower must be situated on a site which will allow the uppor 2/3 of that tower to fall on said site. This law, of course, limits tower location and height because it is not always possible to find tailored sites in a school district which fit the needs of the user.

2500 Megacycle Transmission Equipment

Components shown in the accompanying illustration make up the transmission facility at any given point.

TRANSMITTER FACILITY



2500 MEGACYCLE TRANSMISSION

Transmitters currently on the market are well built and engineered. They are compact in design and generally reliable in operation. Current transmitters have a maximum output of ten watts of power, which is sufficient to cover about a fifteen mile radius providing there are no obstructions in the path of the radiating signal. It must be remembered that the effective range of a 2500 megacycle signal is sharply diminished when the signal is radiating in an omni-directional pattern. Fifteen miles of coverage is about what can be expected from ten watts of power. It is possible to operate at greater power if Federal Communications Commission authorization is granted. This authorization is dependent entirely on each individual situation.

An important point to remember is that one 2500 megacycle transmitter will handle only one channel. If it is desired to use additional channels, then additional transmitters are required for each 2500 megacycle channel used.

An equally important piece of the 2500 megacycle transmission chain which is vital to successful operation, is the transmission line or wave guide material used with the transmitter. This line connects the final output stage of the transmitter with the transmitting antenna on top of the tower. This line in most cases will be at least 100 feet long, and in many cases will be more than 200 feet in length. The length of the transmission line and the type of line used has an effect on the amount of signal which will reach the transmitting antenna. It is possible to start with ten watts of power at the transmitter output stage and end up with only three watts of power at the transmitting antenna, if the wrong type of transmission line is used.

The major concern of 2500 megacycle user is acceptable signal coverage at all receiving locations. This is dependent on having the maximum possible amount of signal radiating from the transmitting antenna. Maximum signal at the transmitting antenna can only be achieved through the use of proper transmission line.

Adaquate signal coverage is also closely associated with type of signal which is being radiated from the transmitting antenna and allied geographical features over which the signal is passing. In a bulletin especially written about 2500 megacycle television by RCA, "2500 Megacycle A Factual Approach", geographical coverage is very adaquately summarized.

> "Where the school district is small in size, with only a few schools, the 2500 megacycle signal could be transmitted in a narrow beam to each receiver location without any great problems, provided there are no major obstructions in the line of sight path from the transmitting to the receiving antennas. If the transmitting beam is very narrow, the signal might be transmitted as far as 25 miles or more.
>
> However, if the school district is large, with many schools, the situation becomes more complex. In this situation, instead of being a simple point-to-point transmission, the many receiving points in all directions may require practically omni-directional transmission. As the angle of the transmitting beam is widened, the power and distance which a signal can be transmitted in any single direction is sharply diminished; beyond four or five miles, it may be necessary to increase the size (and cost) of the receiving antennas to obtain a good signal, or erect booster (translator) stations to cover the desired area beyond that distance."

2500 mc Equipment Cost Analysis

In analyzing the costs of an operational 2500 mc fixed television service, it is necessary to select one of several competitive manufacturers currently marketing this type of equipment. The following cost analysis of a 2500 mc system was furnished by one of the leading manufacturers and represents a typical installation. Most current suppliers' prices are competitive and only individual investigation by an interested party can determine which equipment should be purchased.

The following chart is intended to give an overview of the current costs of a 2500 fixed instructional television service.

	One Channel	Two Channels	Three Channels	Four Channels
Transmitter	$ 15,000	$ 27,000	$ 39,000	$ 51,000
MCTV converters—9 @ $1200	10,800	10,800	10,800	10,800
Master distribution systems—200 classrooms @ $50	10,000	10,000	10,000	10,000
Classroom TV receivers—200 @ $125	25,000	25,000	25,000	25,000
Sub Total	$ 60,800	$ 72,800	$ 84,800	$ 96,800
Maintenance for 10 years @ 12% of above costs per year:	72,960	87,260	101,760	116,160
Total (10 years)	$133,760	$160,160	$186,560	$212,960

Remember, though, that here we are considering the full cost of the equipment. Let us now divide each of the total costs by an amortization period of 10 years to arrive at an annual cost figure. The answers:

For one-channel operation	For two channels	For three channels	For four channels
$ 13,376	$ 16,016	$ 18,560	$ 21,296

It is necessary to take into consideration many factors when planning a 2500 megacycle system. Each installation is unique in design and only speculative figures can be given as to the cost of a particular installation. RCA in "2500 Megacycle A Factual Approach" summarizes the cost of 2500 megacycle installation.

> "Due to the special nature of 2500 megacycle transmission and the fact that each complete system is essentially custom tailored, budgetary figures can only be very rough estimates. In almost all instances, some sort of a preliminary survey will have to be made to determine the number of transmitters, translators, converters, antennas, as well as the height of towers, etc. Depending on the size and complexity of the system, such as in a city, a more extensive survey, on a billable basis, may be required before a complete list of equipment can be furnished and a definite cost established."

Program Production Equipment

Program production equipment and related pieces of equipment at all levels of television production are numerous and varied. It is possible to purchase within almost any price range, equipment that will do the job. Expensive image orthicon cameras to reasonably priced vidicon cameras are available on today's market. It just depends on economic factors and the sophistication of production technique that is appropriate. A 2500 megacycle television operation for a school district will require studio originating equipment which is identical to any other television studio. Items included in all studios are viewfinder camera chains (either image orthicon at $15,000 - $20,000 or vidicon camera at $5,000 - $15,000). A camera chain refers to the camera and its accompaning control unit. Audio and video switching gear is necessary along with video monitors (small television receivers, picture only). Power supplies, lights, a television film chain camera, slide projectors and a host of miscellaneous connectors, cable and allied parts are required.

Most manufactures like to supply a package studio system rather than just a portion of a studio. The complexity of electronic gear has proven that a well planned and integrated system functions with a higher reliability factor than a piece-meal (one camera of one brand, a control unit of another variety).

Although it is not within the scope of this current Office of Education contract to investigate present day production equipment, video tape recorders, receiving equipment, and school distribution systems, these items play such a major role in the total North Circle plan that the research staff could not overlook the opportunity of making certain observations concerning them. Therefore, a much deeper discussion on video tape recorders, distribution systems and production equipment will be found than would normally seem warranted. This is because of the vital part each item has in determining the feasibility of plan under study.

During the entire testing program, professional quality, full interlaced externally synchronized, 800 line cameras were used. The equipment consisted of the following items:

Quantity	Description
2	Cameras, 800 lineviewfinder vidicon
1	Camera, 800 line nonviewfinder vidicon
1	Lens, mark X 200 mm
1	Lens 25 mm
1	Lens 50 mm
1	Lens 75 mm
2	Tripods, elevator type with dollies
3	Camera control units
1	Switcher fader unit
1	Special effects generator
1	Sync generator, EIA standard
1	Distribution amplifier
1	Power supply
4	Video monitors, 8" console-mounted
2	Video monitors, 14" case-mounted
1	Audio tape recorder deck, console-mounted
1	Record turntable
1	Audio pre-amp-mixer
1	Video monitor, 23" case-mounted
2	Microphones, low impedence
1	Video tape recorder, helical scan
22	Television receivers 27" (located at test reception points)

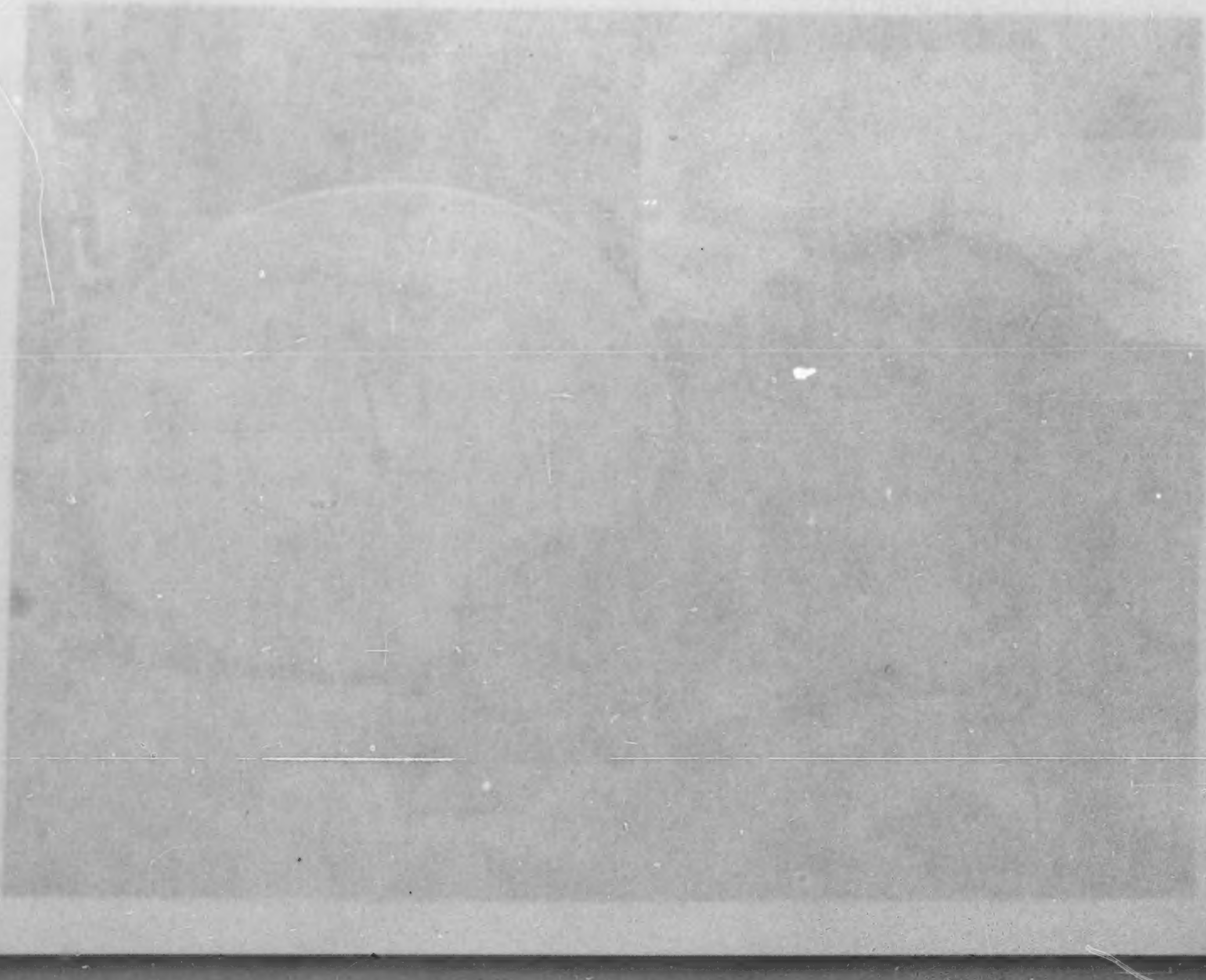
During the entire testing period the previously mentioned equipment was in daily use and functioned properly. The production studio was located in the conference room of the St. Louis County A-V Department in Creve Coeur, Missouri. An adjoining room was used as the control center. Intercom facilities were provided between the two areas which allowed for the use of professional production techniques. During the testing period one thing became apparent to the research staff, and that was the question of trained personnel to make the technical adjustments necessary on the equipment. The research staff would point out that it is essential for qualified personnel to be employed by any school district planning an instructional television system. The production equipment used by the North Circle staff functioned properly. It is always necessary, regardless of the quality of equipment, to have regular maintenance and adjustments performed, and this can only be done by a qualified technician. The overall success of any continuing program is dependent on this factor.

The Federal Communications Commission rules require a third class radio license for any person operating a 2500 megacycle transmitter. The rules also require that any adjustment made to the transmitter be done by a person holding a first class radio operator's license. The need for trained, qualified technical personnel cannot be stressed too strongly by the research staff for any 2500 megacycle program which a school district might be planning.

Test Programming

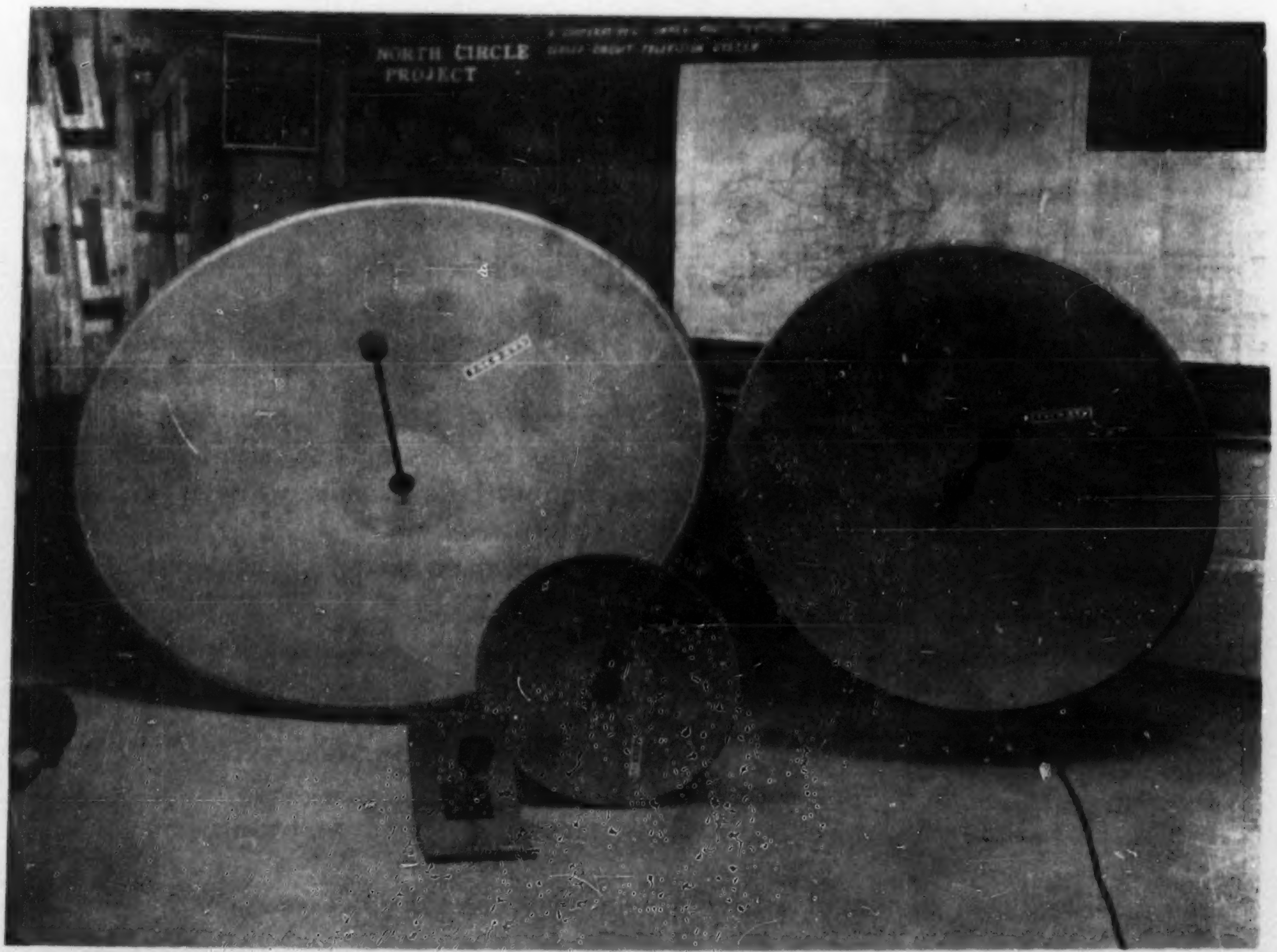
Test programming consisted mainly of a high quality test pattern together with music from each transmitter employed in the tests. Live programming and the transmission of film was done in connection with the curriculum phase of the project and will be discussed in that section. Station identification on the half hour, both visually and audibly, was given.

Every effort was made to maintain the highest quality signal, when transmitting, in order to give optimum information to the reception evaluation teams. All evalautions were made from a test pattern emanating from a live studio camera. It was felt that signal degradation associated with current video tape recorders would not lend credence to test evaluations.



2500 Megacycle Reception Equipment

In order to receive the 2500 megacycle signal radiating from a transmitter, it is necessary to have special receiving antenna such a 2 foot, 4 foot, 6 foot, or 8 foot parabolic dishes. These are shown in the photograph below. It is not possible to receive a 2500 megacycle signal using a standard television antenna. It may be necessary to use up to even a 10 foot parabolic dish if sufficient distance is involved between the transmitter location and the receiving location. This is a trial and error situation and can only be determined on an individual basis.



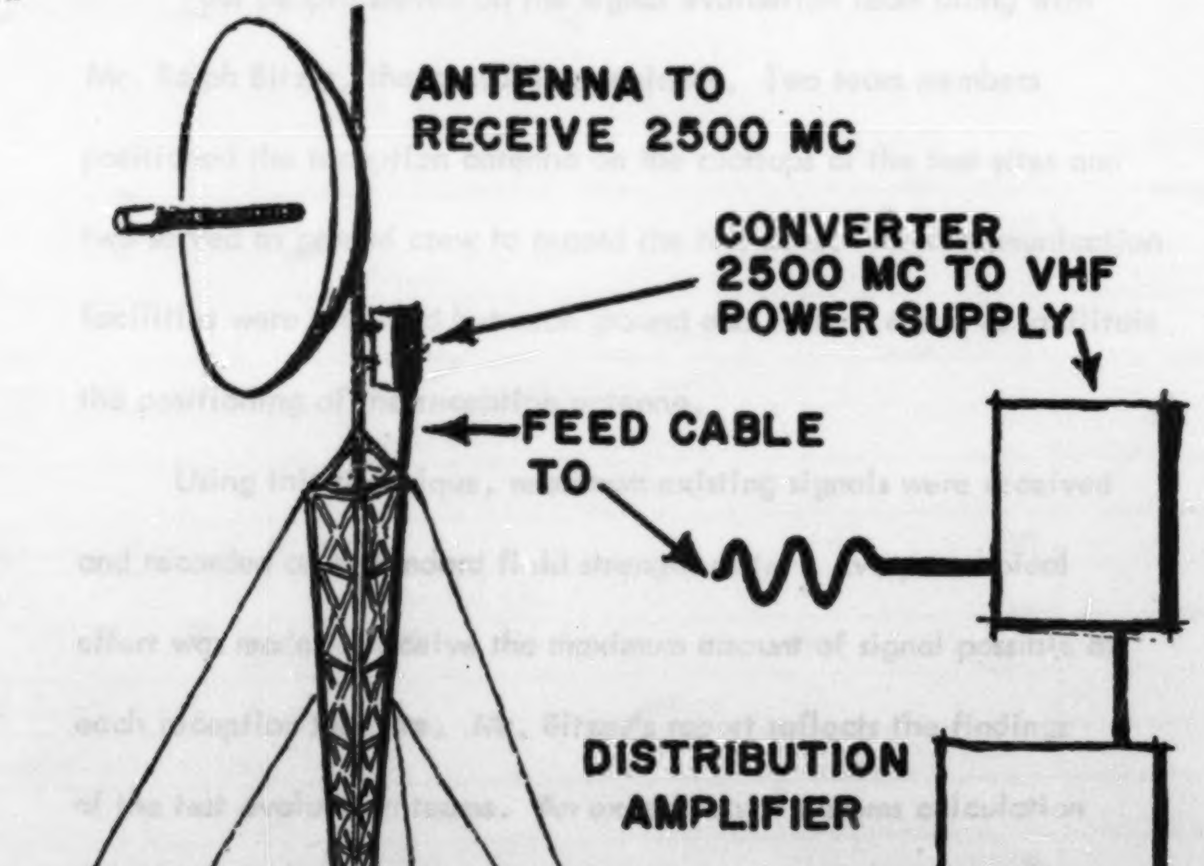
In addition to the parabolic dishes which are required to pick up the signal, it is also necessary to convert the incoming 2500 megacycle signal to a frequency which is available on the standard television receiver. This is done by a special broadband converter that manufacturers have developed. There are different varieties of converters on today's market. Some of them are solid state (no tubes) very compact and light weight; others are quite bulky and are not entirely solid state in their make-up but do an adequate job. Regardless of the brands of converters used, they are necessary items in the 2500 megacycle reception chain. It is important to note that present converters on the market will convert more than one 2500 megacycle channel at a time. Generally speaking, four or five channel conversion at one time is a feature of most converters now being offered.

The final link in the 2500 megacycle reception chain is the distribution system found in the receiving school. This item represents a major link in the chain and will be covered under building facilities and planning for future installations. The following illustration makes up the reception facility required to receive a 2500 megacycle signal. It is an oversimplified drawing intended to give a visual idea of the required equipment necessary.

2500 Megacycle Testing Procedure

Parabolic dishes of various sizes were mounted on rigid tripods, and placed on the roof of reception test sites. A mobile truck, equipped with power supply for converter and television receivers, was used

RECEPTION FACILITY FOR 2500 MEGACYCLE


ANTENNA TO
RECEIVE 2500 MC
CONVERTER
2500 MC TO VHF
POWER SUPPLY
FEED CABLE
TO
DISTRIBUTION
AMPLIFIER
TO DISTRIBUTION
SYSTEM AND OTHER
TV RECEIVERS

throughout the testing program. In addition to the mobile truck facility, standard 27" receivers were placed at various school sites and were used to demonstrate signal reception.

Four people served on the signal evaluation team along with Mr. Ralph Bitzer, the consulting engineer. Two team members positioned the reception antenna on the rooftops of the test sites and two served as ground crew to record the test data. Intercommunication facilities were provided between ground and rooftop crews to facilitate the positioning of the reception antenna.

Using this technique, maximum existing signals were received and recorded on a standard field strength meter. Every technical effort was made to receive the maximum amount of signal possible at each reception test site. Mr. Bitzer's report reflects the findings of the test evaluation teams. An experimental systems calculation chart of the type used by the evaluation teams, is included on the following page to give an idea of the type of data required in order to allow Mr. Bitzer to make observations concerning the 2500 megacycle testing.

EXPERIMENTAL SYSTEM CALCULATION CHART

From ____________________ To ____________________

North Latitude ____________________ North Latitude ____________________

West Longitude ____________________ West Longitude ____________________

Path Length Miles ____________________ Frequency Mc Ch ____________________

Profile Dwg No ____________________

	GAINS	LOSSES
1. Transmitter Output	+ DBW	
Type Power Watts		
2. Transmission Line Loss (db/100 feet)		− DB
Type Length Feet		
3. Transmitter Antenna Gain	+ DB	
Type Polarization		
4. Free Space Loss Miles		− DB
Comments on Profile		
5. Receiving Antenna Gain	+ DB	
Type Polarization		
Totals	+ DBW	− DB
Algebraic Sum of Totals	− DBW	

6. Converter	Type	VHF Conversion Channel No.

7. Receiving Transmission Line (db/100 feet)	− DB
Type Length Feet	

8. Measured Desired VHF Signal Level	uv/m	Ratio Desired
Measured Undesired VHF Signal Level	uv/m	To Undersired

(Undesired with Different Polarity) (uv/m)

9. Theoretical Isotropic Signal for Desired	- DBW	Ratio Desired
Theoretical Isotropic Signal for Undesired	- DBW	To Undesired

(See system calculation chart for undesired signal)

Video Tape Recorders

Few audio visual tools in the history of education have changed teaching methods as dramatically as the low cost portable video taperecorders now appearing on the educational market. The past year, during this contract period, has seen a rapid change in existing recorders and the appearance of new models. It is interesting to note that when the research staff prescribed the low cost video taperecorder as an essential ingredient to the North Circle plan, existing recorders were priced at $60,000. The price has been reduced to $3,000 and gives every indication of further downward adjustment.

The recorder prescribed to fulfill the demands of the proposed system should meet the following minimum standards :

1. A low cost recorder in the $500 to $1,500 catagory
2. Stability of signal of good quality
3. Simple operation
4. Modular construction
5. Light weight, 40 to 60 pounds
6. Minimum maintenance requirement
7. Ability to interchange material with high reliability factor

Recorders which possess all of the above mentioned requirements are not currently available. There is no doubt that in the near future such a recorder will be developed as the demand of the educational market increases. The research staff feels that at the present time lack of standardization of tape devices is retarding, not only the sale, but also the usefulness of present low cost recorders. Despite recent engineering advances on recorders, until the day comes when low cost recorders are standardized so that interchange of material is possible between recorders of different brands, then the real usefulness of the video tape recorder as an educational tool will not be realized.

The February 1963 issue of TAPE RECORDING MAGAZINE contains a comparison chart of these listed available video recorders (reproduced on the following pages):

EXCERPTS FROM TAPE RECORDING MAGAZINE (149)
February, 1965

PICTURES ON TAPE

	Cinerama-Telcan	Fairchild	Norelco
Price	$160 or so	$3000 for console or portable model	$3000 for industrial model
Availability	Telcan has declared bankrupcy	Promised for next month	Expected early this year
Recorder size	Same as conventional tape deck	same as conventional tape deck	About the same as conventional tape deck
Tape	Quarter-inch triple-play tape on 11 1/4" reel	1/4" triple-play tape on 11" reel	Beli eved to use 1" Video tape on 8" reel
Tape cost per reel	$30	$25	No estimate
Tape recording time	22 minutes uninterrupted, 44 minutes per reel	15 minutes uninterrupted 120 minutes per reel @ 120 ips	Unstated
Tape speeds	120 ips	120, 60 ips	6 ips
Number of tracks	2	8	Unstated
Reverse	No	Yes	
Head Life	100 hours	1500 hours	
Head replacement cost	$2	$15	
Heads	2-erase record/playback	2-record and playback. All tape must be bulk erased	
Type of electronics	Transistorized	Transistorized	
Type of motor	Ordinary induction	Ordinary induction	
Connections to TV	Audio, video & horizontal synch. Can be done by qualified TV serviceman for about $15.	Audio, video & Horizontal synch. Can be done by qualified TV serviceman.	
Picture quality	Unsatisfactory for prolonged viewing, comparable to early TV kinescopes. Vertical hold wasn't always reliable	Highly satisfactory compared to TV original. Picture shows slightly less contrast than original at 120 ips. No problem with vertical or horizontal hold	reported to be of very high quality.
Sound quality	adequate--comparable to $59 recorder quality	adequate, comparable to good table FM radio sound	reported to be good
Video camera	$160 extra	included in $3000 price	$500

Loewe-Opta	Par Ltd.	Ampex Signature V	Sony Videocorder
$2500	$250 estimated	$30,000	$600+
Early this year	Still in experimental stage	On sale now	Expected late this year
Slightly larger than conventional deck	Same as conventional deck	Slightly larger than conventional deck	Slightly larger than conventional deck
1" videotape on 8" reel	1/4" triple play tape on 7" reel	1" videotape on 8" reel	1" videotape
$25 estimated	$11.95		$20 for 1 hour
1 hour	24 min. uninterrupted 48 min. per reel @ 30 ips		60 minutes
6 ips	60, 30 ips		7 1/2
1	2		
No	Yes		
Unstated	Unstated		
Unstated	Unstated		
2-erase and slant track record/playback			
Transistorized	Transistorized		
Hysteresis synchronous	Four-pole shaded		
Audio, video & Horizontal synch. Can be done by qualified TV serviceman	Audio, video & Horizontal synch can be done by qualified TV serviceman	Comes complete with TV set	
Nearly as good as Fairchild and quite satisfactory for prolonged viewing despite some darkness at picture edges	Only marginally better than Telcan at 60 ips, with a good deal of show and loss of picture clarity	Well-nigh indistinguishable from TV original	Unavilable at press time
Comparable to FM table radio sound and equal to Fairchild sound.	Nonexistent now, although Par hopes to have wide range stereo sound.	Equals TV reproducer's sound quality	Stereo. Fidelity will be dependent on retail price.
Included in price	$500 estimated	Included in $30,000 price	Yes, but price is not set yet.

There is little doubt that the preceding list will need constant revision, this due to the continuing advances being made in this increasingly competitive, uncontrolled field. It should be stressed again however, that the real usefulness of video taperecorders as a storage and playback tool will not be realized until all recorders are standardized so that interchange of material is possible. The total system as described herein is not feasible without the standardization of video taperecorders.

Conduit Systems and Building Facilities

Present day school distribuition conduit systems are usually not large enough to meet the needs of a system such as proposed here. Unfortunately, architectural thinking has not been advanced enough to envision the possibilities. A 3/4 inch piece of conduit has the capacity to carry no more than 3-standard video cables. Once a 3/4 inch system is installed it remains there for the life of the building and is of relatively little value when one considers that the expected life span of a school building is 50-75 years. In some respects the older school which does not have a conduit system installed is really in much better position because administrators can profit from the mistakes made by installation of the 3/4 inch conduit in newer buildings.

The research staff, in visiting many educational institutions during the contract period (see Appendix G), and talking with suppliers about the problems inherent in conduit systems, have come to several basic conclusions.

1. There is no doubt that future educational needs will demand many cables running through a school building in order to accommodate future electronic media.

2. With many of the foam cables appearing on the market, the trend is toward larger diameter cables which will require a larger conduit system.

3. The research staff would recommend a tray type conduit such as is shown on the following page.

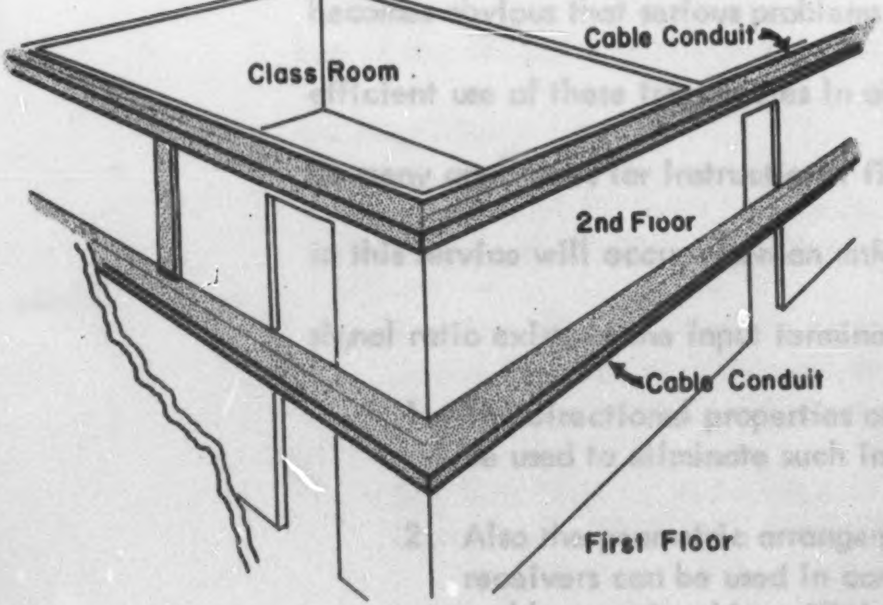
This unit could be designed as an architectural feature housing indirect lighting in a school corrider. It could serve as a carrier for all future video and audio links for the life of a building. Such a tray system would provide easy access to each classroom by using a large junction box just inside each classroom door. A system of this type would have the added advantage of making future additions and maintenance a simple operation. To date there is not such a tray design on the market, but future school buildings will necessitate such design characteristics and administrators should look with interest and concern toward the incorporation of such a tray system.

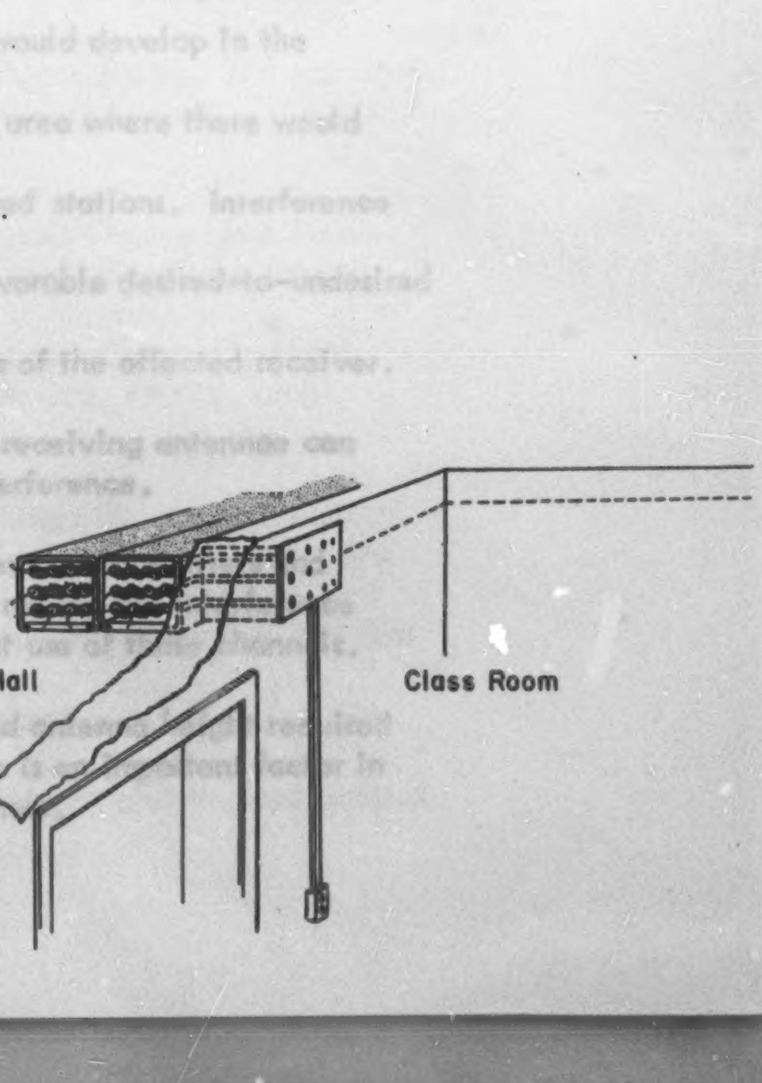
It is to be expected that future school buildings will provide flexible space requirements in order to have multi-purpose, multi-channel audio and video distribution capability within each unit. The electronic folding of classroom walls is a natural outgrowth of this type of planning. Multi-message capability should be uppermost in the thinking and planning of those engaged in school building design. We must begin now to build in the multi-message requirement for the future.

2500 Megacycle Testing Dates

All 2500 megacycle tests were conducted between May 1, 1965 and July 20, 1965. The report can only reflect the study of 2500 megacycle television under optimum weather conditions. High humidity, rain and wind are factors with which the testing team had to contend. Sleet, snow, and icing were not present during testing. It is hoped that further study and testing can be done when these extreme weather conditions do exist in order to see what effect, if any, they will have on 2500 megacycle signal propagation.

The following technical data represents the findings of the engineering consultant to the North Circle research staff. Conclusions reached by Mr. Bitzer and the research staff as to the feasibility of the multiplication of channels will be found at the close of the report.





Grouping of Channels

This phase of the report deals with the allocation problems encountered in the establishment of instructional television fixed stations in the 2500-2680 megacycle band. As indicated in Section 74.902 of the FCC Rules (see Appendix B), there are 31 channels allocated in this band; arranged in seven groups of four channels and one group of three channels. Each individual group contains an arrangement of alternate channels, thus anticipating the use of at least four television channels for each license.

Methods of Eliminating Interference

Since there are only thirty-one channels available, it becomes obvious that serious problems would develop in the efficient use of these frequencies in an area where there would be many applicants for instructional fixed stations. Interference in this service will occur when an unfavorable desired-to-undesired signal ratio exists at the input terminals of the affected receiver.

1. The directional properties of receiving antennae can be used to eliminate such interference.
2. Also the geometric arrangement of transmitters and receivers can be used in controlling the interference problems and making efficient use of these channels.
3. The use of minimum power and antenna height required to provide the needed service is an important factor in the efficient use of the channels.

4. Also in certain cases the use of directional transmitting antennae would provide additional channels.

5. The use of different polarization of the radio wave is also an important factor in eliminating interference.

Test Operational Methodology

In order to develop specific requirements for the use of these instructional fixed channels in a complex populated area, test operations were set up in St. Louis County with the code name North Circle Project under Contract #OE-4-16-024 from the Department of Health, Education and Welfare. Three different experimental test sites were established in St. Louis County after having received authorization from the Federal Communications Commission (BPEX-206).

Transmitter Sites

These three test sites are indicated on the attached topographic map of the St. Louis metropolitan area (Appendix E). The test sites are identified as follows:

Test Site #1 (KI2 XIL) North St. Louis County Mark Twain School, BPEX-206, 1555 Derhake Road, Florissant, Mo.

Test Site #2 (KI2 XIM) South St. Louis County Lindbergh Junior & Senior High School, BPEX-206, 4900 S. Lindbergh Blvd, St. Louis, Missouri.

Test Site #3 (KI2 XIN) West St. Louis County Audio Visual Department, BPEX-206, 1460 Craig Road, St. Louis 41, Mo.

It is to be noted that the airline separation between Test Site #1 and Test Site #2 is 18 miles. The separation between Test Site #1 and Test Site #3 is 10.6 miles. Preliminary planning anticipated co-channel tests between Test Site #1 and Test Site #2. However, initial tests indicated that co-channel stations would be located much closer together than 18 miles. Therefore it was decided to use Test Site #1 as the desired transmitter location and Test Site #3 as the undesired transmitter location with a separation of 10.6 miles. Both Test Site #1 (Mark Twain School) and Test Site #3 (Audio Visual Department) are high clear locations ideal for transmissions in the range under consideration. Many profile radials were completed from the desired transmitter Site #1 to numerous schools that could anticipate service from such transmissions and also be check locations for possible interference.

Towers

It was decided to use one-hundred foot supporting towers for the transmitting antenna in compliance with the efficient use of the channels as outlined in paragraph 2 of this report in item 3. Also the high loss in the available transmission line in this frequency range influenced the selection of one-hundred foot towers.

Flexible 1 5/8 air dielectric coaxial transmission line was selected to deliver the power from the transmitter to the antenna based on practical consideration of installation problems and line loss of 1.2 db per hundred feet. Ultimately a more practical approach using flexible waveguide with a much lower loss will be possible if such equipment becomes available for this frequency.

After preliminary tests it become apparent that using an one-hundred foot supporting tower at Test Site #3 for the undesired transmission, would not yield a measurable signal on most school receiver check locations. Therefore it was decided to use a two-hundred foot supporting tower at the undesired Test Site #3. This in effect would make all conclusions conservative with respect to the separation between desired and undesired transmitter sites.

Presently Section 74.935 of the FCC Rules (Appendix B) anticipates the use of 10 watt transmitters and such equipment is available from various manufacturers. Ten watt transmitters using traveling wave tubes in the final amplifiers were installed at both of the above test locations. Both horizontal polarized and vertical polarized transmitting antennae of the omnidirectional type were available and used in these tests. These transmitting antenna are approximately 8 feet in length having a specified gain of 13 db. The effective radiated power of test #1 (K12 XIL) using a one-hundred foot length of transmission line would be as follows:

Transmitter out	+40 dbw
Transmission line loss	- 1.2 db
Antenna Gain	+13 db
	+51.8 dbw

The effective radiated power of test #3 (K12 XIN) using a two-hundred foot length of transmission line would be as follows:

Transmitter out	+40	dbw
Transmission Line Loss	– 2.4	db
Antenna Gain	+13	db
	+50.6	dbw

Channel Allocation

In selecting a suitable receiving antenna, item (1) of paragraph (2) of this report concerning the efficient allocation on these channels is extremely important. Current receiver design requires a signal of -50 dbw for a proper picture, conservative free space losses would be -105 db for one mile, -111 for two miles, -117 for four miles and -123 db for eight miles. These loss figures alone would not allow sufficient tolerance for 100% reliability required for instructional television and it becomes apparent that high gain receiving antennae should be used both from the standpoint of reliability and efficient use of the spectrum. Various receiving antennae of different design and manufacture were available for these tests. The smaller antennae with a gain of approximately +12 were available in the form of Yagis, corner-reflectors (4 stacked dipoles) and Cylindrical Parabola, but would be limited to receiving locations within one or two miles of the transmitters antenna. They have the advantage of rather simple installation on relatively light 2 to 4 inch pipes. From two miles on out from the transmitting location it would be necessary to consider the higher gains available from parabolic antennae, namely

21 db for 2 foot dish, 27 db for 4 foot dish, 30 db for 6 foot dish, and 33 db for 8 foot dish. Also the use of these higher gain antennae would improve the efficient use of the spectrum due to their improved desired-to-undesired front to back rejection of 27 db for the 2 foot dish, 33 db for the 4 foot dish, 38 db for the 6 foot dish and 42 db for the 8 foot dish. The obvious disadvantage of these higher gain antennae is that their narrow beam width will tolerate using little sway or rotation and must be held rigidly. Therefore a substantial supporting structure must be considered when these high gain antennae are used.

Sophisticated receivers and converters have been designed for use in this band. They are solid slate and installed at the output terminals of the receiving antennae. These receivers have the considerable advantage of the lower lead-in line loss on the converted VHF frequency rather than the high line loss on 2500 mc. Such receivers and converters of this type of several different manufacturers were used in these tests.

Testing Techniques Used

The tests were conducted on Channel C-1 (2548 - 2554 mc) with conversion to the VHF television Channel 8. The converted signal was measured across a 72 ohm line at the input to a standard television receiver. These measurements were made using a Jerrold Model 704-B calibrated Field Strength Meter, Serial No. FSM 5073 (54-220 mc). The technique used in these tests was to first install a suitable antenna on the school rooftop in order to have a satisfactory desired (Test Site #1) signal strength (approximately 300 uv/m) with the receiving antenna beamed toward test transmitter #1. The desired signal strength was then measured and any interference noted on an operating television set tuned to Channel 8. The receiving antenna was then rotated and beamed in the direction of the undesired transmitter site #3. The undesired signal strength was then measured and any interference noted on the television set. The lead-in transmission line for the converter was RG-59U with a characteristic impedance of 72 ohms and generally of the length of about 100 feet. The same line was used for both the desired and undesired signal.

With both test transmitters operating as indicated herein using horizontally polarized transmitting antennae, tests were made at the various locations away from Test Site #1 (Mark Twain) for which profile radials are attached hereto. (Appendix E). In a large percentage of the points tested, a suitable signal strength and picture level could be obtained on the desired signal with the undesired signal being unmeasurable. These test locations varied in distance from one to five miles from Test Site #1.

Test Locations: Co-channel Interference

Two key test locations were selected in these tests as being most susceptible to receiving interference and are indicated on the attached topographic map. (Appendix E) The first of these at the

Berkeley Senior High School (03-01) was selected for its height and nearness to the undesired station:

Distance to Site #1 (K12 XIL) 3.4 miles A2 44.5°

Distance to Site #3 (K12 XIN) 7.0 miles A_2 232.0°

The second of these at the Halls Ferry School (07-12) was selected since its receiving antenna, when beamed toward the desired station, would have the least possible rejection of all receiver locations considered:

Distance to Site #1 (K12 XIL) 1.3 miles A_2 177.0°

Distance to Site #3 (K12 XIN) 11.4 miles A2 223.5°

With both transmitters operating with horizontally polarized antennae, tests were made at the Halls Ferry School indicating a suitable picture level from Test Site #1 whereas the signal level from Test Site #3 was unmeasurable.

Co-channel Test Results

With both transmitters operating with horizontally polarized antennae, tests were made at the Berkeley Senior High School (03-01). The desired signal level was 300 uv/m with a well defined picture, but subject to a varying co-channel interference pattern. The undesired signal level was 120 uv/m with a fair picture subject to severe interference. The exact nature of the undesired signal and interference to the desired operation was confirmed when the undesired transmitter was turned off, thus eliminating all interference on the desired signal.

Polarized Antenna Test Results

Next the undesired horizontally polarized transmitting antenna was replaced with a vertically polarized antenna. Both transmitting antennae had a gain of +13 db. Testing was then resumed at the Berkeley Senior High School with both transmitters operating. The desired signal level was 310 uv/m with a well defined picture and no evidence of interference. The feed horn on the receiving antenna was rotated 90 degrees and the antenna beamed toward undesired test Site #3. The undesired signal level was 135 uv/m with a fairly good picture.

Factors Related to Interference: Line of Sight, Low Power, Height of Towers, Efficient High Gain Antenna

It is evident that at many of the test locations the undesired signal could not be measured due to lack of line of sight transmission. This is equally important in receiving the desired signal. All reliable systems must be designed so that each receiver location has line of sight transmission with the transmitting antenna. However, it is also important in the efficient use of this instructional television band that no more than necessary antenna height and power be used in order to limit interference. Low power and low antenna height will allow co-channel stations to be spaced closely together without interference. Further, the FCC Rules anticipate such efficient use of the spectrum and in particular insist upon the use of efficient receiving equipment. The FCC will authorize new transmitting stations even in those cases where interference will be caused to existing receiver locations where it can be demonstrated that the interference will be eliminated through the use of more efficient and high gain receiving antennae.

Repeated Use of Channels

In conclusion it can be summarized that how often a single channel can be repeated in a large populated area would be dependent on the transmitting antenna height, effective transmitting power, the use of efficient receiving antenna and the use of opposite polarity at different transmitting locations. In general, if transmitting stations on the same frequency were operated with the effective radiated power considered herein and transmitting antenna height of one-hundred feet, they could be located eight miles apart if they used opposite polarity. Such a station could expect a radius coverage of about five miles. Further, if the transmitting station required only a limited usage of two miles radius it could be operated with reduced tower height and power; and thus stations on the same frequency utilizing opposite polarity could be separated by as little as five miles. It is conceivable that even up to 15 mile radius coverage could be obtained by using a suitably tall supporting tower and transmitting equipment. Such coverage could then be readily anticipated without serious impact on the allocations particularly if the far receiving locations were to use highly efficient eight and ten foot receiving dishes. This latter coverage has a practical aspect in providing connecting links as indicated herein with the county transmission sites at Mark Twain School (Site #1) and Audio Visual Department (Site #3) with important city receiving locations. It is obvious from the foregoing that the thirty-one channels assigned in Section 74.902 of the FCC Rules and Regulations could provide several hundred television channels in a metropolitan area if properly used.

Multiple Signal Selection from Single Antenna Receiver Location

Overall planning in a metropolitan area is a necessity if the thirty-one channels under consideration are to be used efficiently. Further, the grouping of transmitters together on a single tower or in the same general area would provide a multiple signal selection from a single antenna receiver location. Such planning would provide a great economic saving to the individual schools, and afford the greatest possible selection of different television signals.

Recommendations: Weatherproofing, Maintenance, Operating Personnel

The use of the 2500 mc band for covering wide areas as considered herein is a new concept calling for new techniques and equipment. Good engineering practices must be followed if satisfactory multiple channel television transmissions are to be achieved. As previously indicated, line of sight between the transmitting antenna and receiving antenna is extremely important. Intervening foliage must be taken into consideration and compensated for with increased height of antenna. Of equal importance is the weatherproofing of the equipment both at the transmitting and receiving ends. Operation in this range of frequencies will not tolerate the penetration of moisture into the transmitting antennae or the coaxial transmission lines, or into the feed horns of the receiving antennae. Further, since the converters and receivers are mounted at the output terminals of the receiving antenna they too must be properly weatherproofed to withstand all conditions. All items of hardware must be designed on the basis of continuous service and a regular schedule of maintenance conducted. Since the transmitting antenna and transmission lines would have an air dielectric it would be imperative that reliable end seals be used and the lines kept under constant pressure with a dry gas. Informed and qualified personnel must be available for both the operation and maintenance of the equipment.

Combined Systems: CCTV and Cable Installations

When only a relatively small area is to be covered with a multiple television transmission system having a radius coverage of 1000 feet to 2000 feet, an all cable distribution system would be attractive from an economic standpoint and would also conserve channels for needed long distance air transmissions. No doubt such a cable system would be interlinked with an off the air television network. Such a hybrid system using off the air transmission and cable techniques is a natural development in the face of the ever increasing demand for instructional television channels from many different types of users and applicants.

Future 2500 mc Channel Allocations

In view of Mr. Bitzer's findings, it seems only logical that the ultimate outcome should be a computer program study which will insure maximum allocation of channels in a metropolitan area.

This is an essential step if 2500 mc television in greater St. Louis or any other metropolitan area is to realize its maximum potential. This step must not be long in coming, as many educational agencies are looking with great anticipation to this medium of television signal distribution pending issuance of the North Circle report. It must be conducted before indiscriminate allocation of 2500 mc channels developes.

Typical data for such a computer study would, among other items, necessarily include for program development such information as:

1. Distance and terrain involved in the area to be studied.

2. Significant manmade structures which could prove to be obstacles to a 2500 mc signal.

3. Federal and local regulations relating to electronic signals and tower height restrictions.

4. Location of proposed reception points for the 2500 mc signal.

5. Available coverage groups practical plus the number of channels needed with minimum spacing figures between transmitter points.

Such a computer study in greater St. Louis or in other metropolitan areas of necessity must honor all the requirements of the various educational agencies planning 2500 mc fixed television service. In the St. Louis area the following agencies have expressed an interest in 2500 mc telecasting and their channel requests would need to be included in any computer program.

1. Thirty St. Louis County school districts.
2. Missouri University at St. Louis.
3. St. Louis University.
4. Washington University.
5. St. Louis Archdiocese school system.
6. Lutheran schools of greater St. Louis.
7. City of St. Louis school district.
8. St. Louis County Junior Colleges.

This list clearly demonstrates the need for multi-channel capabilities to meet the many requirements of educational groups. In as much as the demands can be met through utilization of the 2500 mc fixed television service, it is imperative that a computer channel study be undertaken to insure maximum channel allocation for all.

The search for an economical multi-channel carrier of pictures, sounds and symbols cannot be limited to 2500 megacycle alone. Whatever success 2500 megacycle displays in meeting the criteria for message distribution must be compared with the alternate modes.

Even though limiting discussion to closed-circuit television (eliminating, for the time being the truck system, postal system, open-circuit television system and other message carriers) the investigation finds non-2500 mc avenues worthy of consideration.

On a nation-wide basis, the telephone utility companies offer instructional television distribution facilities on a lease basis, and private companies offer to install cabled or micro-wave systems on lease or sale basis. Research staff members have visited installations in Columbus, Ohio, Washington County, Maryland, Chicago, Illinois, Colorado Springs, Colorado, Columbia, South Caroline, and Anaheim, California to view cabled closed-circuit installations. There is no question as to the ability of cabled systems to provide television messages equal to, and in some cases better than, current 2500 megacycle-transmitted messages. Leased or self-owned cable systems of distribution have no restrictions placed on availability regarding the number of channels, other than the ability of the user to pay for the number of needed channels.

If 150 channels in a given area can be supplied by BOTH 2500 megacycle fixed-station service and cabled techniques with equal satisfaction (in terms of signal quality) there must be factors other than technical capability upon which to base use-decisions. Long and short term costs which take maintenance and operating costs, as well as capital outlay, may be the determining factor in soundly based choice.

The telephone rates or equipment and maintenance costs which are herein quoted may not be apropos later or have any validity in future decision making. Though such costs are listed in Appendix D these figures are but for the sake of illustration. In spite of the unstable nature of cost quotations, there are generalizations which will probably bear up.

1. The more closely placed the receiving points, the more economical is cabled closed-circuit as opposed to 2500 megacycle television.

2. The more diverse or distant (up to a point) the receiving points, the more economical is 2500 megacycle as opposed to cabled television.

3. At a certain point in distance, microwaved television is more economical than either cabled or 2500 megacycle television.

Conclusion

As a practical conclusion based on this research, the project staff believes that an urban-suburban complex of school systems which requires extensive use of television will find a hybrid system composed of four kinds of television transmission useful because of differences in terrain, distance, and kinds of message. The four elements are:

1. Cabled closed-circuit television as a potential basic carrier
   2500 megacycle television as potential basic carriers.
3. Open-circuit television as a secondary carrier.
4. Microwaved television as a relay link over long distances.

The location and amount of use for each element will be determined by the relative costs of each television form and load requirement. No "pure" 2500 megacycle, "pure" cabled, or "pure" open-circuit system is practical. Proper hybridizing of the four elements will comprise the multi-channel system required for instruction, materials-distribution, and administrative data handling in an area similar to Greater St. Louis.

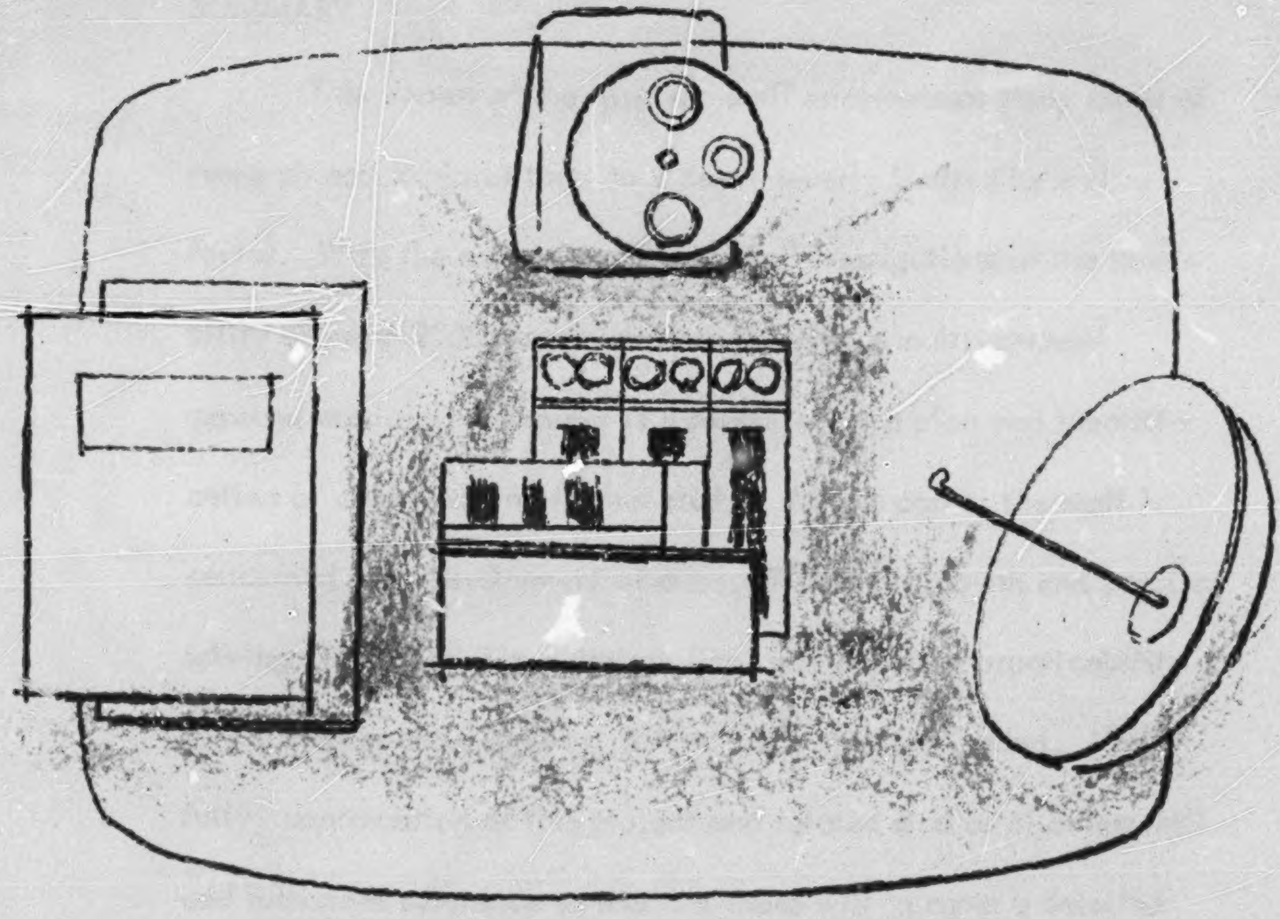
Other "Multi'Channel" Techniques Possible: Increased speed, Multiplexing, Split Screen

Cost or scarcity of channels may make having 150 channels impractical. It should be recognized that the number of channels required is determined by the number of messages to be sent. It might be more accurate to state the requirements for channels in terms of message capacity, rather than number of channels. Perhaps 15 "high speed channels" which can do the work of 150 present day channels can carry the same message load in a given time period. As an example, one of the more intriguing (but everyday) processes used in duplicating magnetic audio tape recordings is to play a 3 3/4 inches per second tape recording at 7 1/2 or more inches per second. The machine sounds shrill and garbled (much like a cartoon film character). A wire attached to the machine's speaker terminals is then attached to the input of a second tape recorder. This second machine is recording the output of the first machine (even though the sound is garbled) at the same speed at which the first machine is playing. The recording thus made will be garbled when played back. However, if this recording is played back at 3 3/4 inches per second, it will be an intelligible duplicate original recording. Not only is this a demonstration of some of the interesting things which can be done in transferring magnetic recordings; this is an exercise which takes only half the time, or less, than it would require to make the duplicate tape without changing speeds. Through the interconnecting wire between recorders it is possible to pass TWO such high speed messages in the same time as ONE normal "slow" playing would require.

The above is an understandable and elemental illustration of how "high speed" transmission of videotape recordings might allow a television channel to serve as two or more channels in terms of message carrying capacity. Not so understandable and elemental is the discussion of bandwidth which should accompany any discussion of high speed transmission of messages. For now, know that all major users of television (military, commercial, industrial and educational) will stand in awe and respect of those who solve the problems which prevent such high speed transmission from being a serviceable means for gaining high message capacity over few channels. The stubborn fact of physics which currently precludes high speed transmission is that it takes the equivalent of two channels to double the speed. . . a frustrating phenomenon which cancels out the virture of doubling the speed.

The foregoing is submitted to illustrate the number of approaches which can be taken in seeking a high message-capacity for television. Other methods include the science of multiplexing signals (as in stereo FM radio) and split-screen (as in special effects display of two images on a single screen).

Whatever the other routes, including possible future applications of laser beams and television transmission over common telephone lines, 2500 megacycle television stands beside coaxial cable as the only means currently available to achieve the number of simultaneous channels education will demand in the immediate future.



SECTION NINE

SECTION IX

SUMMARY

This report of the project staff encompasses many areas of research and explores them to a depth severly limited by a time factor. With the exception of specific investigations of the possibility of using 2500 megacycle television as a multi-channel message carrier, the project is a formation of a plan and identification of areas needing further study. At this point the staff is concerned with development of a master plan for growth and problem solving. As credibility, desirability and apparent practicability of the plan became clearer, further study seemed needed. Hopefully, continuation of this project and related studies of others will add sufficient substance so that the ideas will become a detailed blueprint which can be followed by potential system builders.

No specific criteria of feasibility can be applied until such time as the ideas in the 'plan' can be reduced to elements of a blueprint. The Cooperating Schools A-V Corporation and its staff intends to continue development of the project to the point where the financial, administrative, technical, and educational feasibility can be determined. It is hoped that this report provides information and motivation to others who would search for better ways to do that which we are all trying to do . . . . . .provide the best and most efficient system possible for public instruction.

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GLOSSARY OF CLOSED - CIRCUIT TELEVISION TERMS:

Amplifier:	A device which increases the power, voltage or current of a signal.
Antenna:	A conductor or system of conductors with which radio or television signals are received or transmitted through space. Some antennas are formed of suspended wires; others are formed of metal rods. In a microwave system a parabolic reflector or dish is imployed for this purpose.
Attenuation:	A reduction in electrical signal strength.
Attenuator:	A device to decrease signal strength (Sometimes called a "pad".
Audio:	An electrical signal representation of the sound portion of a TV program.
Audio Video Mixer:	A device to mix together audio and video for transmission purposes.
Automatic Light Compensator:	Facility that automatically adjust a TV camera for changing light levels.
Band:	A range of frequencies within two definite limits and used for a definite purpose; for example, the standard AM broadcast band extends from 550-1600 kilocycles, VHF television from 54-216 megacycles, and UHF TV from 470-890 megacycles.
Bandwidth:	The frequency range required to transmit information, whether audio, video, or both. Home TV channels are telecast in the U.S. with a bandwidth of six megacycles.
Camera:	In television, an optical electronic device that picks up and translates images into electrical impulses.
Camera Chain:	A television camera connected to a control unit and viewing monitor.
Carrier:	The transmitted electrical wave that carries the video or audio signals or impulses impressed upon it.

Channel:	A specific band of frequencies assigned to each radio or television station. In some closed-circuit applications, the video and audio signals are modulator turned to a specific channel, enabling the signals to travel by means of a coaxial-cable system rather than through space.
Channel Allocation:	The channel or band in the radio spectrum to which a television station is assigned, or the channel space in the radio spectrum to which a communication service is assigned.
Closed Circuit:	A wire circuit or microwave relay system used as a means of carrying and continuing a television program for specialized audience viewing.
Co-axial Cable:	Two conductor cables that consists of conductive tubing with a wire inside. Inner and outer conductors are insulated from each other.
Contrast:	The ratio of white and black parts of a TV picture. Low contrast pictures are grayish. High contrast pictures have strong blacks and whites.
Control Console:	A piece of equipment that incorporates monitors for viewing separate images picked up by various TV cameras in a system, in addition to the switching and other control devices required. When remote-controlled cameras are used, special iris, lens focus, and pan-tilt circuits are included.
Converter:	An electronic device capable of changing radio and television signals from one class of frequencies to another. Attached to a TV receiver, a converter allows a VHF set to tune in UHF channels. Similarly, a converter installed at the antenna site can perform the same function to permit distribution of the modified signals to many television receivers not ordinarily equipped to receive such signals.
Depth of Field:	The latitude or range within which a lens will keep an object in sharp focus at a given setting.
Dish:	The parabolic reflector usually used to direct signals in the *receiving or transmitting* unit of a microwave relay.

Dolly:	A platform or frame equipped with wheels or casters on which the tripod or pedestal supporting TV cameras or other equipment is mounted.
Effective Radiated Power (ERP):	The energy actually transmitted in the horizontal plane from the antenna of an FM or television station.
EIA (Retma) Standards:	A set of criteria and standards worked out by research committees to arrive at a working basis for commercial broadcast TV equipment--both transmission and reception. The Electronics Industry Association (EIA), formerly known as RETMA, was responsible for activating this important work.
Fader:	An electronic control that progressively decreases the intensity of an image picked up by a TV camera. This procedure can disappears entirely, or the process can be reversed to fade in another image.
Film Chain:	An equipment arrangement in which one or more 16-mm film projectors are directed in turn to provide image pickup for a television camera. This may include the projector, mulitplexer, and TV camera.
Focal Length:	The distance from the center of a lens to where the image is in focus.
Frame:	A complete TV image.
f/Stop:	Refers to the "speed" or ability of a lens to pass light. It is calculated by dividing the focal length of the lens by its diameter.
Gray Scale:	Variations in value from white, through shades of gray, to black on a television screen. The gradations approximate the tonal values of the original image picked up by the TV camera. Some systems are capable of producing a relatively high number of gradations in the gray scale, whereas others may be rather limited.
Image Orthicon:	A highly sensitive TV camera tube used extensively in studio cameras, as well as for field applications.
Image Orthicon Tube:	Photo sensitive camera tube used in commercial TV studios.
Impedance:	The total opposition a circuit offers to flow of AC current.

Impedance Match:	Equalization of circuit impedances matching impedances allows maximum transfer of power from one portion of circuit to another.
Intercommunication Line:	Usually the audio connection between the TV director and the members of the crew. In some closed-circuit applications, talk-back audio lines have been installed to permit verbal interchange between students and teachers in remote classrooms and the TV teacher.
Interlaced Scanning:	An electronic television method where an image is broken down into elements by moving a electron beam that scans odd or even lines alternately.
Iris:	An adjustable aperture built into each camera lens to permit control of the amount of light passing through the lens.
Kilocycle:	A measurement unit equal to 1,000 cycles per second and used to express the frequency of radio and other electromagnetic waves.
Kinescope:	Originally applied to the direct-view picture tube on which the image is formed in a TV receiver (now obsolete). Now usually applied to the film recording of a TV program made from the images appearing on a television screen.
Kinescope Recorder:	A device with which a film recording is made of a television program. The film camera records the images directly from the face of a TV tube.
Lens Speed:	Refers to the ability of a lens to pass light. A fast lens would be rated f/1.4; a much slower lens might be designated as f/8. The larger the f number the slower the lens.
Lens Turret:	An accessory on a television camera which holds several different lenses in an arrangement designed to permit rapid interchange through rotation from wide angle to telephoto.
Lighting	
Back Light:	Illumination from behind the subject used to emphasize the effect of depth in a scene.
Barn Doors:	Hinged metal plates attached to certain lighting sources. The manipulation of these plates permits better control of the light falling on the set.

Lighting	
Cross Light:	Illumination of the subject or scene from two different directions forming approximately equal angles with the optical axis of the camera. This lighting is supplied from sources in front of the object being televised.
Eye Light:	A special source of illumination designed to effect desirable reflection from the eyes and teeth of a subject without substantially affecting the over-all lighting condition.
Fresnel:	A special lens with concentric circle forms impressed in its front surface to focus spotlight beams for use in studio lighting. May be obtained in a variety designs with restricted focusing from a 16° beam to a flood beam of 70°.
Fill Light:	Auxiliary illumination to lessen contrast range or to reduce shadows.
High-Key Lighting:	Illumination pattern of a scene resulting in a picture with gradations mainly between white and gray. Dark-grays and blacks are present but are limited.
Key Light:	The lighting effect indicating the direction of the major source of illumination of a scene.
Low-Key Lighting:	Illumination pattern of a scene resulting in a picture with gradations from middle-gray to black with few areas of light-grays and whites.
Pantograph:	A light-fixture suspension device with provision for raising and lowering the light source; unit extends or contracts in much the same way as an accordion.
Scoop:	A floodlight employed to illuminate large areas at close range.
Set Light:	Auxiliary illumination of the background or set, in addition to the lighting supplied for the major subjects or areas.
Side Back-Light:	Off-center illumination behind the subject.
Spotlight:	Lighting fixture offering a concentrated beam of illumination. Models vary from small low-wattage units to large 5,000-watt arrangements.

Line-of-Sight:	A term popularly employed to describe transmission characteristics of broadcast television channels and other high-frequency bands. Such frequencies are useually limited in transmission range by straight-line distances between the radiating antenna and the receiving antenna. Natural or man-made obstructions existing between the sending and receiving positions further limit coverage.
Line Scanning Frequency:	The number of lines of an image scanned each second; under present U.S. standards it is 15,750 cycles per second, which corresponds to a 525-line picture.
Lip Sync:	The production of a film or kinescope with recorded sound track that is synchronized with the spoken words of the person or persons involved in the film. Films that do not incorporate lip sync might have a narrator's voice recorded on the film.
Low-Power Telecasting:	Under amended rules of the FCC, TV stations can now be operated with as little as 100 watts of effective radiated power. Prior to this ruling the minimum ERP was 1,000 watts.
Magnetic Tape:	An acetate or plastic ribbon coated on one surface with tiny iron oxide particles. The 1/4" width tape is ordinarily employed for magnetically recording audio for subsequent reproduction. Special tapes of greater width are used for magnetic storage of data in computers. The most recent development is the 2-inch width used in video tape recording the entire television program, including the audio, video, and synchronizing and control signals.
Master Antenna System:	An arrangement designed to eliminate need for individual antennas for each receiver. Antennas are arranged to pick up television signals in a given service area and are connected to an amplification and distribution network to provide optimum signals to multiple locations within one or more buildings.
Master TV Control:	The point or points at which all TV signal assimilation occurs for subsequent controlled distribution through a closed circuit system; this includes control of all inter-communications signals, TV signals, etc.

Megacycle:	1,000,000 cycles per second; used to express the frequency of radio, television, and other electromagnetic waves.
Microwave Relay:	A system that receives and rebroadcasts an original signal to cover long distances between the original signal source and the final receiver.
Mobile Unit:	A truck or trailer equipped with television units to permit the pickup of programs in the field. Some units are equipped with microwave facilities to communicate with the home-base station.
Modulator:	A device that combines the video signal from a TV camera and the audio signal from a microphone or similar source and impresses them on a carrier signal for transmission on a closed-circuit system.
Monitor:	Closed-circuit TV video receiver used to display TV picture only.
Multiplexer:	Any device or circuit used for combining signals. For example--in a closed-circuit system several VHF channels are combined for simultaneous transmission over a single coaxial tube.
Narrow-band Channel:	Refers to the proposal advanced by the Midwest Airborne Instructional Television Center to experiment with television channels of half the standard width (3 megacycles as compared to the standard of 6 megacycles). If successful, the system could result in making more individual channels available for telecasting purposes.
Noise:	Undesirable voltages originating in the TV equipment or from an external source. It causes interference with the received picture.
Oscilloscope:	A test instrument, similar in some respects to a TV receiver, that shows visual patterns of voltage and current characteristics.
Pan:	Moving a television camera unit in a horizontal plane.
Picture Tube:	The cathode-ray tube in a TV receiver that reproduces images.
Projection TV:	A TV receiver that uses lenses to project a cathode-ray tube picture on a screen. The image is generally much larger than the TV receiver's picture tube image.

Radio Frequency (RF):	Commonly abbreviated as RF electrical energy capable of being radiated over great distances. Considered the part of the frequency spectrum between audio and infra-red light. In CCTV, this is further narrowed to the 10 MC to 220 MC range.
Random Interlace:	Scanning system that uses less precise timing methods than the interlace scanning method.
Random Sync:	A system of control impulses employed to govern some television cameras not designed to meet EIA (RETMA) standards for on-the-air equipment. Random sync cameras are employed for industrial and educational purposes where EIA pulses are not required.
Relay Station:	A station used to receive picture and sound signals from a master station and to transmit them to a second relay station or to a television station transmitter.
Remote Control:	Operating a device from a distance either mechanically or electrically.
Remote-Controlled Camera:	A TV camera equipped with accessories to permit its manipulation and adjustment by means of electronic controls. With propoer equipment, lens changing, focusing, panning, tilting, and iris control can be effected from a remote position.
Remote-Control Console:	An installation including the switches and controls necessary to originate the impulses that operate the camera and modify its functions.
Repeater:	A device for receiving, amplifying and re-transmitting a signal or wave.
Resolution:	Ability of a system to reproduce fine details.
Satellite Stations:	VHF broadcast stations located within the area of service of another television broadcast station, licensed by the same ownership and intended primarily to repeat the same program to extend the service to an adjacent area; technical requirements are precisely the same as specified for regular license.
Scanning:	The process of deflecting the electron geam in a camera or picture tube so that it moves at high speed from left to right in a sequence of rows or lines from top to bottom, thus changing light and shadows of a scene into electrical impulses to form the image on the receiver tube.

Sensitivity:	Characteristics of an electronic device that determines its ability to respond to minimum input signals.
Signal Multiplexing:	A device for the mixing of several signals for transmission over a single system. Microwave relays are often multiplexed to carry video and audio signals simultaneously.
Signal to Noise Ratio:	The ratio of the TV signal intensity to the noise or interference intensity accompanying it.
Simulcast:	The simultaneous transmission of the same program over two different stations. In some instances, this is done with a pair of AM and FM stations, or the audio portion is broadcast over a ration station while the complete program is sent out over a television station.
Splitter:	A device that divides one signal into two or more signals.
Synchronization:	Maintaining the electron beam of a TV receiver in step with the scanning beam of a camera tube.
Synchronizing Generator:	An electronic generator that supplies pulse patterns for the control of television circuits. EIA (RETMA) pulses are required for on the air; random or non-EIA pulses may be employed for local systems of a closed-circuit nature.
Talk-back:	Use of an intercommunication system to provide voice contact between the television director and the crew or, in some closed-circuit applications, to permit students in remote classrooms to ask questions of the television instructor.
Tally Light:	Signal lights installed at the front and back of TV cameras to inform perfomers and crew members when a particular camera is on the air.
TV Broadcast Signal:	A combination of two radio frequency carriers spaced by 4.5 MC per sec., the lower one being amplitude-modulated by a standard composite picture signal, the upper one being frequency-modulated by the accompanying audio signal.
TV Channel:	The term "television channel" means a band of frequencies 6 megacycles wide in the TV broadcast band and designated either by number or by the extreme lower and upper frequencies.

Tilt:	Moving a television camera in a vertical plane.
Translator:	An electronic device capable of receiving a TV transmission from a VHF station and converting it for retransmission on a UHF channel. A translator can also be used to pick up a program from a UHF channel and retransmit it on a different UHF channel.
Transmitter:	A general term applying to the equipment necessary to radiate radio or television signals into space for reception at locations within the service area.
Tuner-adapter:	A device attached to a VHF television receiver that enables it to also tune in UHF channels.
UHF:	An abbreviation for ultrahigh frequencies. By definition these extend from 300 to 3,000 megacycles.
VHF:	An abbreviation for very high frequencies. By definition these extend from 30 to 300 megacycles.
Video:	Refers to the visual components of a TV system. Video frequency is the range obtained from scanning by a TV camera tube.
Video Amplifier:	An amplifier having characteristics suitable for amplifying video signals.
Video-tape Recorder:	A device capable of recording both the audio and video signals of a TV production on a special magnetic tape, which can be played back to reproduce the entire program.
Vidicon:	A TV camera tube of much smaller physical size than the image orthicon. The vidicon requires more light for comparable operation but is less expensive in cost and operation.
Zoom Lens:	A special camera lens whose focal length or angle of view is continuously adjustable and always in focus on an object or scene within its wide range.

APPENDIX A

The following is reproduced from the National Association of Educational Broadcaster's *Journal*, November-December, 1963. It appeared under the title "The Schools and the TV Spectrum" by Grace Knecht and Robert J. Nissen.

"The electromagnetic spectrum is a limited natural resource. This incontrovertible fact is at the heart of the problem of the expansion of broadcast instructional television in the United States. Only a certain portion of the limited spectrum can be used for television broadcasting. And television broadcasting--being the spectrum spacehog that it is (one television channel occupies the same space as 560 standard AM broadcast channels), severely limits the number of channels which can be accommodated.

"The physical limitation of the spectrum is a fact on which social or political action can have no effect whatsoever. To alter this fact is outside the realm of mere human effort. The efficient utilization of the spectrum may be improved by technical means but, nonetheless, there remain specific and practical limitations which must be reckoned with.

"How the television broadcast portion of the spectrum is *used*, however, is a matter which *can* be controlled by social and political actions. This is the problem of "allocations"--who gets what portion of the limited spectrum. The FCC is charged with the responsibility of riding herd on the spectrum. The Commission's actions are governed by the Communications Act which repeatedly emphasizes that the use of the spectrum shall be in the "public interest, convenience, and necessity." The FCC must constantly consider what effect a particular use of the spectrum will have on the entire public.

"The FCC has given long and serious consideration to the needs of education for spectrum space. In word and in action, it has shown itself to be strongly pro-ETV. But the spectrum remains a limited natural resource. And, in the current proposal by the FCC for a new table of allocations, it has proposed that only 692 allocations be reserved for ETV--clearly far short of the estimated requirement for 1197 channels.

"To base future ITV plans on the availability of broadcast spectrum space is flying in the face of hard physical fact. It is not feasible that the limited broadcast spectrum be used in the long range future for the internal communication purposes of academic systems. We propose that closed-circuit methods are the only suitable means for providing the bulk of this service.

CONCLUSIONS

"It is impractical for in-school instructional television to rely, in the future, on the use of broadcast channels as its principal method of distribution. This is not to suggest that ITV programs presently being broadcast on ETV channels should be discontinued. The broadcast method of distribution is a major one at the present time, and there is considerable evidence that it will expand in the next few years. But if plans now being made for ITV systems, not yet in operation, do not take into serious consideration the limitations of the broadcast spectrum, years of backtracking lie ahead.

"We maintain that only if the FCC were capable of allocating, and willing to allocate, at least twenty instructional broadcast channels to a metropolitan area--with proportionately fewer in smaller communities--would the use of broadcast channels for this purpose be feasible. With the cold fact of a jammed spectrum, this kind of a decision by the FCC is clearly out of the question. Even if enough channels could be allocated, the inherent advantages of closed-circuit ITV would probably rule in its favor.

"We realize that a proposal to separate ITV from ETV may not be received with enthusiasm by those ETV stations whose bread and butter comes from their ITV service, or by those stations which find a welcome side income from their instructional programming. But the break between instructional television and public noncommercial broadcasting will inevitably be forced by the extreme shortage of spectrum space. Educators and ETV broadcasters would do well to face up to the problem now.

"Neither the cause of instructional television, nor the 'interest, convenience, and necessity' of the public can be served by the long-term planned use of a limited broadcast spectrum--with its unique ability to communicate with the entire public--for the internal communications purposes of an academic system. Broadcasting is broadcasting--not narrowcasting."

The following position paper is excerpted from EDUCATIONAL TELEVISION'S DILEMMA (What is Happening to the Dream?) by Arthur Hungerford, Associate Professor Penn State University, as used at the December 7-8, 1964 Conference on the Long-Range Financing of Educational Television Stations.

"Educational television broadcasting, on the threshold of multi-million dollar expansion, is schizophrenic. The reason is its reluctance to answer a two-pronged question: should it align itself principally with the formal educational system, or should it commit itself to becoming a broad cultural service--an "alternate" system to the present system of commercial broadcasting?

"A choice must be made. There are not enough standard broadcast channels (channels 2-83) to permit full development of a multi-channel formal educational service to the schools. Postponing the proper financing of the other facet--cultural and informational broadcasting--can only result in continued underdevelopment of an effective "alternate" non-commercial system.

"A choice must be made now, and it should be a studied choice, before the number of educational television stations increases to a point where the die is cast, and before it is too late to establish a national philosophy for broadcast educational television and a sound pattern for financing it . . .

"Basically, there are two philosophies underlying the present ETV broadcasting service. According to one, ETV should become an extension of the educational FM radio service, which would bear some resemblance to the Third Programme of the British Broadcasting Corporation's radio division. This would be a cultural and informational television service. According to the other, the contribution of educational broadcasting should be in the more formal instructional setting, and this would be a television service primarily in cooperation with schools. Most ETV leaders try to serve both masters--formal educational broadcasting and cultural or informational broadcasting . . .

"When financing becomes difficult--and this is practically always--educational television stations, regardless of ownership, tend to seek the solid base of support of which schools, colleges and universities are capable of providing. All station owners, be they schools themselves, institutions of higher learning, community ETV organizations, or state commissions, have found that the one assured and continuing source of support for ETV stations is in the arena of formal instruction. Thus, program schedules are heavily oriented toward classroom television from grammar school through college; programming analyses across the country show that approximately one-half of all ETV programming is of the in-school variety.

". . .There is no question that it has a future based upon need. To the degree that ETV stations serve this need for direct instruction and enrichment, they are financed by the same sources that currently support the schools--local and state governments. Undoubtedly, in-school television has great potential. With already overloaded facilities ever increasing student enrollments, and "unequal" educational opportunities, it is anticipated that every school system of any size may need the equivalent of several television stations to send classrooms simultaneous lessons in a wide variety of subject areas. But it is not necessary--and it may not be desirable--that formal education make extensive use of broadcast television channels.

"In July 1963, the FCC, recognizing the needs of the schools for multi-channel service, set aside 31 channels in the 2500 megacycle band for the exclusive use of educational institutions. The new band of frequencies gives plenty of room for sending out several simultaneous transmissions so that each school can have a considerable choice of lesson materials. This flexibility is not possible with standard broadcast channels. There just are not enough of them under the present allocation plan.

"Because ordinary home receivers cannot accept signals from stations operating in the 2500 megacycle band, the educators have, in effect, private facilities that will give them a maximum of academic freedom. They will not have to worry about what a lay audience might think about the programming, as they might when using standard broadcast channels.

"FCC Commissioner Robert E. Lee has already indicated informally that educators will be encouraged to use the 2500 megacycle band for in-school television, thus releasing the standard broadcast ETV channels for programming to the home audience.

"The availability of special channels for in-school television, and pressure from the Federal Communications Commission to use them, could arrest the ETV broadcasters in their retreat to the classroom. What will be left for ETV will be adult education and cultural and informational broadcasting, oriented toward the home viewer. Yet these are the very programming areas well known for difficulties in securing adequate financing. . ."

APPENDIX B

SUBPART I—INSTRUCTIONAL TELEVISION FIXED STATIONS

DEFINITIONS AND ALLOCATION OF FREQUENCIES

§ 74.901 Definitions.

Attended operation. Operation of a station by a qualified operator on duty at the place where the transmitting apparatus is located with the transmitter in plain view of the operator.

Instructional television fixed station. A fixed station operated by an educational organization and used primarily for the transmission of visual and aural instructional, cultural, and other types of educational material to one or more fixed receiving locations.

Remote control. Operation of a station by a qualified operator on duty at a control position from which the transmitter is not visible but which control position is equipped with suitable control and telemetering circuits so that the essential functions that could be performed at the transmitter can also be performed from the control point.

Unattended operation. Operation of a station by automatic means whereby the transmitter is turned on and off and performs its functions without attention by a qualified operator.

§ 74.902 Frequency assignments.

(a) The following frequencies may be assigned to instructional television fixed stations:

Group A		Group B		Group C		Group D	
Channel No.	Band limits Mc/s	Channel No.	Band limits Mc/s	Channel No.	Band limits Mc/s	Channel No.	Band limits Mc/s
A-1....	2500-2506	B-1...	2506-2512	C-1...	2548-2554	D-1...	2554-2560
A-2....	2512-2518	B-2...	2518-2524	C-2...	2560-2566	D-2...	2566-2572
A-3....	2524-2530	B-3...	2530-2536	C-3...	2572-2578	D-3...	2578-2584
A-4....	2536-2542	B-4...	2542-2548	C-4...	2584-2590	D-4...	2590-2596

Group E		Group F		Group G		Group H	
Channel No.	Band limits Mc/s	Channel No.	Band limits Mc/s	Channel No.	Band limits Mc/s	Channel No.	Band limits Mc/s
E-1....	2596-2602	F-1...	2602-2608	G-1...	2644-2650	H-1...	2650-2656
E-2....	2608-2614	F-2...	2614-2620	G-2...	2656-2662	H-2...	2662-2668
E-3....	2620-2626	F-3...	2626-2632	G-3...	2668-2674	H-3...	2674-2680
E-4....	2632-2638	F-4...	2638-2644	G-4...	2680-2686		

(b) The frequency band 2500-2690 Mc/s is shared with operational fixed and international control stations. Assignments to new instructional television fixed stations will not be made where interference will be caused to existing stations operating in accordance with the Table of Frequency Allocations in § 2.106 of this chapter. Similarly, assignments to new operational fixed or international control stations will not be made where interference will be caused to existing instructional television fixed stations. Existing operational fixed and international control stations may employ different channeling and this fact should be kept in mind in assessing potential interference.

(c) Applicants proposing operation of up to four transmitters at a single location shall specify channels in only one of the groups listed in paragraph (a) of this section. An applicant proposing operation of less than four transmitters at a single location may request that the remaining channels in the group be reserved for future expansion of the system. The Commission will undertake to avoid assigning the remaining channels in the group to other applicants for so long as such action is feasible in the judgment of the Commission. If operation of more than four transmitters is proposed by an applicant or if a proposed multichannel system involves reception of one instructional television fixed station at the transmitter location of other stations in the same system, the applicant may specify a channel in a different group. Initially, a single applicant will be limited to a single channel in the additional group and requests for the reservation of channels in more than one group will not be honored. This limits the number of channels available to a single licensee for use in a single area of operation to five, but shall not be construed as guaranteeing as many as five channels to any licensee. The area of operation of a station is considered to be the area within which the use of a channel by one licensee precludes its use by other licensees.

(d) The same channel may be assigned to more than one station or more than one licensee in the same area if the geometric arrangement of the transmitting and receiving points or the times of operation are such that interference is not likely to occur.

[*§ 73.902 as amended eff. 7-1-64; III(64)-1*]

§ 74.903 Interference.

(a) Since interference in this service will occur only when an unfavorable desired-to-undesired signal ratio exists at the antenna input terminals of the affected receiver, the directive properties of receiving antennas can be used to minimize the hazard of such interference. Interference may also be controlled through the use of directive transmitting antennas, geometric arrangement of transmitters and receivers, and the use of the minimum power required to provide the needed service.

(b) An application for a new instructional television fixed station is expected to take full advantage of such techniques to prevent interference to the reception of any existing operational fixed, international control station or instructional television fixed station at authorized receiving locations. In cases where it can be demonstrated that potential interference could be effectively controlled with practical refinements at such existing receiving locations, the user of the receiving installation is expected to make the needed refinements if interference-free reception is desired.

(c) Existing licensees and prospective applicants are expected to cooperate fully in attempting to resolve problems of potential interference before bringing the matter to the attention of the Commission.

ADMINISTRATIVE PROCEDURE

§ 74.911 Cross reference.

See §§ 74.11 to 74.16.

LICENSING POLICIES AND GENERAL OPERATING REQUIREMENTS

§ 74.931 Purpose and permissible service.

(a) Instructional television fixed stations are intended primarily to provide a means for the transmission of instructional and cultural material in visual form with an associated aural channel to specified receiving locations for the primary purpose of providing a formal education and cultural development to students enrolled in accredited public and private schools, colleges, and universities.

(b) Such stations may also be used for the additional purpose of transmitting visual and aural material to selected receiving locations for in-service training and instruction in special skills and safety propersons and groups engaged in professional and techgrams, extension of professional training, informing nical activities of current developments in their particular fields, and other similar endeavors.

(c) During periods when the circuits provided by these stations are not being used for the transmission of instructional and cultural material, they may be used for the transmission of material directly related to the administrative activities of the licensee such as the holding of conferences with personnel, distribution of reports and assignments, exchange of data and statistics, and other similar uses. Stations will not be licensed in this service solely for the transmission of administrative traffic.

(d) Stations may be licensed in this service for operation as relay stations to interconnect instructional television fixed station systems in adjacent areas, to deliver instructional and cultural material to commercial and noncommercial educational television cultural material to, and obtain such material from, commercial and noncommercial educational television broadcast stations for use on the instructional television fixed system, and to deliver instructional and cultural material to, and obtain such material from, nearby terminals or connection points of closed circuit educational television systems employing wired distribution systems or radio facilities authorized under other parts of this chapter.

(e) Material transmitted by these stations may be intended for simultaneous reception and display or may be recorded for use at a later time.

§ 74.932 Eligibility and licensing requirements.

(a) A license for an instructional television fixed station will be issued only to an institutional or governmental organization engaged in the formal education of enrolled students or to a nonprofit organization formed for the purpose of providing instructional television material to such institutional or governmental organizations, and which is otherwise qualified under the statutory provisions of the Communications Act of 1934, as amended. A nonprofit organization which would be eligible for a license for a noncommercial educational television broadcast station is considered to be eligible for a license for an instructional television fixed station.

(1) In determining the eligibility of publicly supported educational organizations, the accreditation of the appropriate state department of education will be taken into consideration.

(2) In determining the eligibility of privately controlled educational organizations, the accreditation of the appropriate state department of education or the recognized regional and national accrediting organizations will be taken into consideration.

(b) No numerical limit is placed on the number of stations which may be licensed to a single licensee. However, individual licensees will be governed by the limitation of § 74.902 as to the number of channels which may be used. A single license may be issued for more than one transmitter if they are to be located at a common site and operated by the same licensee. Applicants are expected to accomplish the proposed operation by the use of the smallest number of channels required to provide the needed service.

(c) An application for a new instructional television fixed station or for changes in the facilities of an existing station shall specify the location of the transmitter and all proposed receiving installations which will be under the control of the applicant or will be equipped for reception by the applicant. If reception is also intended at unspecified locations, i.e., if power is deliberately radiated to locations or areas so that voluntary reception will be possible, the applications shall include a complete statement as to the purpose of such additional reception.

§ 74.933 Remote control operation.

(a) An instructional television fixed station may be operated by remote control if the following conditions are met:

(1) The transmitter and associated control system shall be installed and protected in a manner designed to prevent tampering or operation by unauthorized persons.

(2) An operator meeting the requirements of § 4.965 shall be on duty at the remote control position and in actual charge thereof at all times when the station is in operation.

(3) Facilities shall be provided at the control position which will permit the operator to turn the transmitter on and off at will. The control position shall also be equipped with devices suitable for observing the overall characteristics of the transmissions and a carrier-operated device which will give a continuous visual indication whenever the transmitting antenna is radiating a signal. The transmitting apparatus shall be inspected as often as may be necessary to insure proper operation and in any event at least once a day.

(4) The control circuits shall be so designed and installed that short circuits, open circuits, other line faults, or any other cause which would result in

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loss of control of the transmitter, will automatically cause the transmitter to cease radiating.

(b) An application for authority to construct a new station or to make changes in the facilities of an existing station and which proposes operation by remote control shall include an adequate showing of the manner of compliance with the requirements of this section.

(Sec. 318, 48 Stat. 1089, as amended; 47 U.S.C. 318)

§ 74.934 Unattended operation.

(a) Unattended operation of an instructional television fixed station will be permitted only when it is used for relaying the signals of another station which is employing the transmission standards specified for stations operating in this service and then only if the following requirements are met:

(1) The transmitter shall be equipped with automatic circuits which will permit it to radiate only when a signal on the channel which it is intended to retransmit is present at the input terminals of the apparatus. The automatic circuit may be provided with a reasonable time-delay factor to prevent the transmitter from being turned off during momentary failures of the incoming signal.

(2) The transmitter shall accomplish the relaying of the incoming signal by direct heterodyne frequency conversion to a different channel, or linear amplification of the incoming signal. The use of a common oscillator to convert the incoming signal to a low frequency for amplification and to reconvert it to its original channel will be considered to be the same as linear amplification. In cases where frequency conversion to a different channel is employed, the electrical characteristics of the incoming signal when retransmitted shall not be significantly altered except as to frequency and amplitude. In cases where linear amplification is employed, the electrical characteristics of the incoming signal when retransmitted shall not be significantly altered except as to amplitude. Care shall be taken in the design and installation of an unattended relay station to prevent instability which could result in spurious or other unwanted radiation.

(3) If the transmitting apparatus is located at a site which is not readily accessible at all hours and in all seasons, means shall be provided for turning the transmitter on and off at will from a location which can be reached promptly at all hours and in all seasons.

(4) The transmitter and any associated control circuits shall be installed and protected in a manner designed to prevent tampering or operation by unauthorized persons.

(5) In cases where the antenna supporting structure of an unattended station is required to have aeronautical hazard markings pursuant to the provisions of Part 17 of this chapter, the licensee shall provide for inspection and logging of observations of such markings as required by §§ 17.37 and 17.38 of this chapter.

(b) An application for authority to construct a new station or to make changes in the facilities of an existing station and which proposes unattended operation shall include an adequate showing as to the manner of compliance with the requirements of this section.

(Sec. 318, 48 Stat. 1089, as amended; 47 U.S.C. 318)

§ 74.935 Power limitations.

(a) The power of an instructional television fixed station will be limited to that required to perform the proposed service. Applicants are expected to take full advantage of the power-concentrating properties of directive transmitting antennas and the collective properties of directive receiving antennas to provide the needed service.

(b) An application for a new instructional television fixed station or for changes in the facilities of an existing station proposing a peak visual power output from the transmitter in excess of 10 watts shall include a showing as to the distance and direction to each specified receiving point, the elevation above ground and the power gain of each receiving antenna at such receiving points, the vertical and horizontal directive patterns of the proposed transmitting antenna system in terms of power gain, the elevation of the transmitting antenna above ground and the nature of significant terrain features over the transmission path or paths.

(c) The operating power (peak visual) of an instructional television fixed station shall not be permitted to exceed the authorized power by more than 10 percent at any time.

(d) The transmitter power output of the aural signal shall not be more than 70 percent nor less than 10 percent of the peak power output of the visual signal.

§ 74.936 Emissions and bandwidth.

(a) An instructional television fixed station shall normally employ amplitude modulation (A5) for the transmission of the visual signal and frequency modulation (F3) for the transmission of the aural signal.

(b) The average power of radio frequency harmonics of the visual and aural carriers, measured at the output terminals of the transmitter, shall be attenuated no less than 60 decibles below the peak visual output power within the assigned channel. All other emissions appearing on frequencies more than 3 Mc/s above or below the upper and lower edges, respectively, of the assigned channel shall be attenuated no less than:

(1) 30 decibels for transmitters rated at less than 10 watts visual peak power output.

(2) 40 decibels for transmitters rated at 10 watts or more visual peak power output.

(c) Should interference occur as the result of emissions outside the assigned channel, greater attenuation may be required.

§ 74.937 Antennas.

(a) In order to minimize the hazard of harmful interference from other stations, directive receiving antennas should be used at all receiving points. The choice of receiving antennas is left to the discretion of the licensee. However, should interference occur and it can be demonstrated that such interference could be eliminated through the use of a more suitable yet practical directive receiving antenna, the licensee of the station causing the interference is absolved of the responsibility of correcting the interference condition.

(b) Directive transmitting antennas shall be used wherever feasible so as to minimize the hazard of harmful interference to other licensees. The radiation pattern shall be designed to minimize radiation in directions where no reception is intended.

(c) In selecting a location for the transmitting antenna, it should be borne in mind that interference to the reception of its transmission is most likely to come from the direction in which receiving antennas must be aimed to receive its transmissions. Whenever possible the location should be chosen so that the receiving antennas in its system are aimed in directions from which interfering signals are least likely to come.

(d) The use of elevated receiving antennas is preferable to the use of elevated transmitting antennas or greater power to provide the desired service.

(e) The use of vertical or horizontal plane polarization or right-hand or left-hand rotating (circular) polarization may be used to minimize the hazard of harmful interference between systems. The Commission reserves the right to specify the polarization to be used.

(f) The power gain compared to an isotropic antenna and the directive properties of the transmitting and receiving antennas proposed to be employed, as well as the geometric distribution of the transmitting and receiving points, shall be supplied with each application for a new educational television fixed station or for changes in the antenna facilities of an existing station.

§ 74.938 Transmission standards.

(a) Except as otherwise provided in this section, the transmission standards employed by television broadcast stations and set forth in § 73.682 of this chapter shall apply to instructional television fixed stations.

(b) Instructional television fixed stations are not required to attenuate the lower sideband by any specified amount unless interference to the reception of another station results from emissions in excess of those permitted television broadcast stations, in which case the attenuation specified in § 73.687(a)(3) of this chapter shall apply. However, in no case shall the amplitude of any lower sideband component exceed the amplitude of the upper sideband component having the highest amplitude.

(c) The visual transmission amplitude characteristics may vary from those specified in § 73.682 of this chapter to the extent that such variations result from permissible lower sideband radiation. Care should be exercised in the adjustment of the transmitter to insure correct overall response of the transmitter for transmission of the upper and vestigial lower sideband.

(d) The provisions of § 74.937 in lieu of § 73.682(a)(14) of this chapter apply with respect to polarization of the radiated signal.

(e) The provisions of § 74.935(d) in lieu of § 73.682(a)(15) of this chapter apply with respect to the ratio of visual to aural power.

EQUIPMENT

§ 74.950 Equipment performance and installation.

(a) Except as otherwise provided in this section, the requirements of § 73.687 of this chapter regarding the installation and performance of television broadcast transmitters and associated equipment shall apply to instructional television fixed stations.

(b) The overall attenuation characteristics of the transmitter may vary from those specified in § 73.687 of this chapter to the extent that such variations result from permissible lower sideband radiation. However, care should be exercised in the adjustment of the transmitter to insure correct overall response of the transmitter for proper transmission of the upper and vestigial lower sideband.

(c) The provisions of § 74.961 in lieu of § 73.687(c)(1) of this chapter apply with respect to the frequency tolerance for the visual carrier.

(d) The provisions of § 74.936 in lieu of § 73.687(i)(1) of this chapter apply with respect to spurious emissions and radiofrequency harmonics.

(e) The requirements of § 73.687(c)(2) of this chapter will be considered to be met insofar as measurements of operating power are concerned, if the transmitter is equipped with instruments for determining the combined visual and aural operating power. However, licensees are expected to maintain the operating powers within the limits specified in the rules of this part. Measurements of the separate visual and aural operating powers should be made at sufficiently frequent intervals to insure compliance with the rules and in no event less often than once a month.

(f) Transmitting apparatus used solely for relaying signals received from other stations and operating in the manner described in § 74.934(a)(2) shall, in lieu of the requirements of § 73.687 of this chapter, comply with requirements of § 74.750 (c), (e), and (f).

§ 74.951 Equipment changes.

(a) Formal application (FCC Form 330P) is required for any of the following changes:

(1) Replacement of the transmitter as a whole, except replacement with an identical transmitter, or any change in equipment which could result in a change in the electrical characteristics or performance of the station.

(2) Any change in the transmitting antenna system, including the direction of radiation, directive pattern, antenna gain, or transmission line.

(3) Any change in the height of the antenna above ground or any horizontal change in the location of the antenna in excess of 500 feet.

(4) Any change in the transmitter control system.

(5) Any change in the location of the transmitter except a move within the same building or upon the same tower or pole.

(6) Any change of frequency assignment.

(7) Any change of authorized operating power.

(b) Other equipment changes not specifically referred to in paragraph (a) of this section may be made at the discretion of the licensee, provided that the Engineer in Charge of the radio district in which the station is located and the Commission in Washington, D.C., are notified in writing upon the completion of such changes and provided further, that the changes are appropriately reflected in the next application for renewal of license of the station.

§ 74.952 Acceptability of equipment for licensing.

(a) Transmitters employed in this service must have type acceptance by the Commission. Type acceptance may be given under either of the following conditions:

(1) A transmitter or translator may be type accepted upon the request of any manufacturer of such equipment built in quantity by following the type acceptance procedure set forth in Part 2 of this chapter, provided that the date and information submitted indicate that the equipment meets all technical requirements applicable to this service. If accepted, such transmitting equipment will be included on the Commission's "Radio Equipment List, Part C, Equipment Acceptable for Licensing in the Radio Services Other than Broadcast." Applicants specifying equipment included on such a list need not submit detailed descriptions and diagrams where the correct type number is specified, provided that the equipment proposed is identical with that accepted. Copies of the Radio Equipment List, Part C, are available for inspection at the Commission's office in Washington, D.C., and at each of its field offices.

(2) An application specifying a transmitter or translator not included on the Radio Equipment List, Part C, may be accepted upon the request of a prospective licensee submitting, with the application for construction permit, a complete description of the equipment, including the circuit diagram, listing of all tubes used, function of each, multiplication in each stage, plate current and voltage applied to each tube, and a description of the oscillator circuit together with any devices installed for the purpose of frequency stabilization. However, if this data has been filed with the Commission by a manufacturer in connection with a request for type acceptance, it need not be submitted with the application for construction permit but may be referred to as "on file." Measurement data for type acceptance made in accordance with subparagraph (1) of this paragraph shall be submitted with the license application.

(b) Additional rules with respect to withdrawal of type acceptance, modification of type accepted equipment, and limitations on the findings upon which type acceptance is based are set forth in Part 2 of this chapter.

TECHNICAL OPERATION AND OPERATORS

§ 74.961 Frequency tolerance.

(a) The frequency of the visual carrier shall be maintained within 60 kilocycles of the assigned frequency at all times when the station is in operation.

(b) The frequency of the aural carrier shall be maintained in accordance with the provisions of § 73.687(c)(1) of this chapter.

§ 74.962 Frequency monitors and measurements.

(a) Suitable means shall be provided to insure that the operating frequencies of the station are within the prescribed tolerances.

(b) The operating frequencies shall be checked as often as is necessary to insure that they are within the prescribed tolerances at all times and in all cases the operating frequencies shall be checked at intervals of no more than 1 month.

(c) A determination of the operating frequencies of the visual and aural carriers may be made by measuring any exact submultiple of the actual output frequency. Any crude but suitable device, including a roughly calibrated receiver, may be used to determine that the output frequency is the correct multiple of the frequency controlling element in the transmitter.

§ 74.963 Time of operation.

(a) An instructional television fixed station is not required to adhere to any regular schedule of operation. Unless otherwise specified in the license, the hours of operation are not limited.

(b) Except for purposes of tests and adjustments, the transmitter shall not be permitted to radiate unmodulated carriers or otherwise make unnecessary transmissions for extended periods of time.

§ 74.964 Station inspection.

The station and all records required to be kept by the licensee shall be made available for inspection upon request by any authorized representative of the Commission.

§ 74.965 Posting of station and operator licenses.

(a) The station license and any other instrument of authorization or individual order concerning the construction of the equipment or manner of operation shall be posted at the place where the transmitter is located, so that all terms thereof are visible, except as otherwise provided in paragraphs (b) and (c) of this section.

(b) In cases where the transmitter is operated by remote control, the documents referred to in paragraph (a) of this section shall be posted in the manner described at the control point of the transmitter, and

(c) In cases where the transmitter is operated unattended, the name of the licensee and the call sign of the unattended station shall be displayed at the transmitter site on the structure supporting the transmitting antenna, so as to be visible to a person standing on the ground at the transmitter site. The display shall be prepared so as to withstand normal weathering for a reasonable period of time and shall be maintained in a legible condition at all times by the licensee. The station license and other documents referred to in paragraph (a) of this section shall be kept at the nearest attended station operated by the licensee of the unattended station or in cases where the licensee of the unattended station does not operate attended stations, at the point of destination of the signals relayed by the unattended station.

(d) The original of each station operator license shall be posted at the place where he is on duty: *Provided, however,* That if the original license of a station operator is posted at another radio transmitting station in accordance with the rules governing the class of station and is there available for inspection by a representative of the Commission, a verification card (FCC Form 758–F) is acceptable in lieu of the posting of such license: *Provided further, however,* That if the operator on duty holds an operator permit of the card form (as distinguished from the diploma form), he shall not post that permit but shall keep it in his personal possession.

§ 74.966 Operator requirements.

(a) An instructional television fixed station, used for the origination of visual and aural program material or the transmitter of which is modulated with visual and aural program material received from other sources, shall not be operated unless there is one (or more) operators holding a valid radiotelephone first-class or second-class operator license or radiotelephone third-class operator permit, on duty at the place where the transmitter is located or at an authorized control point established pursuant to the provisions of § 74.933, and in actual charge thereof.

(b) Except when under the immediate supervision of a radiotelephone first-class or second-class operator, the radiotelephone third-class operator permit holder may perform only the following functions:

(1) Those necessary to turn the transmitter on and off.

(2) Such adjustments as may be made by means of external controls and which are necessary to maintain modulation of the transmitter within the prescribed limits.

(3) Such adjustments as may be made by means of external controls and which are necessary to compensate for fluctuations of the power supply voltage which would otherwise result in changes in the authorized operating power.

(4) Make routine meter readings and inspection of antenna hazard marking for logging purposes.

(c) In cases where a transmitter is operated unattended pursuant to the provisions of § 74.934, an operator of the grade specified in paragraph (a) of this section shall observe the transmissions at the receiving point for the station or some other suitable place where the transmissions of the unattended station can be observed, at intervals of no more than 1 hour whenever the station is in operation. Should any condition of improper operation be observed, immediate measures shall be instituted to correct the condition of improper operation.

(d) Any tests, adjustments, or repairs made while the transmitter is in operation and which require technical skill and knowledge to avoid improper operation, shall be made by or under the immediate supervision of an operator holding a valid radiotelephone first-class or second-class operator license.

(e) The licensed operator on duty and in charge of an instructional television fixed station may, at the discretion of the licensee, be employed for other duties or for the operation of another station or stations in accordance with the class of operator license or permit which he holds and the rules and regulations governing such stations. However, such duties shall in no way impair or impede the required supervision of the instructional television fixed station.

(Sec. 318, 48 Stat. 1089, as amended; 47 U.S.C. 318)

§ 74.967 Marking and lighting of antenna structures.

The marking and lighting of antenna structures authorized by the Commission, where required, will be specified in the authorization issued by the Commission. Part 17 of this chapter sets forth the circumstances under which such marking and lighting will be required and the responsibility of the licensee with regard thereto.

§ 74.968 Additional orders.

In case the rules of this part do not cover all phases of operation with respect to external effects, the Commission may make supplemental or additional orders in each case as may be deemed necessary.

§ 74.969 Copies of the rules.

The licensee of an instructional television fixed station shall have current copies of Parts 73 and 74, and in cases where aeronautical hazard marking of antennas is required, Part 17 of this chapter available for use by the operator in charge. Both the licensee and the operator or operators responsible for the proper operation of the station are expected to be familiar with the pertinent rules governing instructional television fixed stations.

§ 74.970 Modulation limits.

(a) *Visual transmitter.* The maximum excursion of the luminance signal in the white direction shall not exceed the value specified in § 73.682(a)(13) of this chapter for the reference white level.

(b) *Aural transmitter.* The maximum frequency swing of the aural carrier shall not be permitted to exceed ±25 kc/s on peaks of frequent occurrence during any transmission. This is defined as 100 percent modulation.

§ 74.971 Modulation monitors and measurements.

Suitable means shall be provided to insure that the modulation limits specified in § 74.970 are observed.

OTHER OPERATING REQUIREMENTS

§ 74.981 Logs.

(a) The licensee of an instructional television fixed station shall maintain an operating log showing the following:

(1) The date and time of the beginning of each period of operation of the transmitter.

(2) The date and time of any unscheduled interruptions to the transmissions of the station, the duration of such interruptions, and the causes thereof.

(3) The date and time of the end of each period of operation of the transmitter.

(4) A record of all repairs, adjustments, maintenance, tests, and equipment changes, showing the date and time of such events, the name and qualifications of the person or persons performing such tasks, and a brief description of the matter logged.

(5) Where an antenna structure is required to have aeronautical hazard markings, the information required by § 17.38 of this chapter.

(b) The log entries shall be made by the person or persons competent to do so, having actual knowledge of the facts required, who shall sign the log when starting duty and again when going off duty.

(c) The log shall be kept in an orderly and legible manner, in suitable form, and in such detail that the data required are readily available. Key letters or abbreviations may be used if proper meaning or explanation is contained elsewhere in the log.

(d) No log or portion thereof shall be erased, obliterated, or willfully destroyed within the period of retention required by rule. Any necessary correction may be made only by the person who made the original entry who shall strike out the erroneous portion, initial the correction made, and show the date the correction was made.

(e) Operating logs shall be retained for a period of not less than 2 years. The Commission reserves the right to order, in individual cases, retention of logs for a longer period of time. In cases where the licensee has notice of any claim or complaint to which information contained in the log may be pertinent, the log shall be retained until such claim or complaint has been fully satisfied or until the same has been barred by statute limiting the time for the filing of suits upon such claims.

§ 74.982 Station identification.

(a) Call signs for instructional television fixed stations will consist of three letters and two digits pursuant to the provisions of § 2.302 of this chapter relating to fixed stations.

(b) Except as otherwise provided in paragraphs (c) and (d) of this section, each instructional television fixed station shall transmit its call sign at the beginning and end of each period of operation and, during operation, on the hour. Visual or aural transmissions shall be employed.

(c) The hourly station identification announcement during operation may be deferred if it would interrupt a single consecutive demonstration, lecture, or other similar discourse or otherwise impair the continuity of a program in progress. In such cases the station identification announcement shall be made at the first normal break in the continuity of the program.

(d) In cases where an instructional television fixed station is operating as a relay for signals originating at some other station operated by the same licensee, its call sign shall be announced by the originating station at the times and in the manner prescribed in paragraph (b) of this section.

(e) In cases where an instructional television fixed station is operating as a relay for signals originating at a station operated by some other licensee, its call sign may be transmitted by the originating station if suitable arrangements can be made with the other licensee or in lieu thereof, means shall be provided for the transmission of the call sign by the relay transmitter itself. If the transmitter is operating unattended or if it is not equipped for direct modulation by a locally generated signal, the transmission of the call sign may be made automatically in the manner prescribed in § 74.783(a).

§ 74.984 Retransmissions.

An instructional television fixed station may not retransmit the signals of any class of station without consent of the station originating the signals to be retransmitted.

(Sec. 325, 48 Stat. 1091; 47 U.S.C. 325)

U.S. GOVERNMENT PRINTING OFFICE: 1964 O—720-802

APPENDIX C

COUNTY OF ST. LOUIS)
) SS
STATE OF MISSOURI   )

Ralph J. Bitzer, first being duly sworn upon oath, deposes and says that he is a Consulting Broadcast Engineer of St. Louis, Missouri and is acting herein as engineering consultant on the North Circle Project under Contract OE-4-16-024 from the Department of Health, Education and Welfare in an investigation of the allocation of instructional television stations in the 2500-2680 mc band. He states that he is a registered professional engineer in the State of Missouri E-5639, dating from July 1950. His qualifications as an engineer have been given before the Federal Communications Commission and have been accepted. He further states that he supervised the aforementioned experimental tests on 2500 mc; and that the calculations, exhibits and conclusions in the foregoing report were made by him personally and that they are based on information and facts which are true to his own knowledge or on information which he believes to be true.

Ralph J. Bitzer
Ralph J. Bitzer, Affiant

Subscribed and sworn to before me this 20 day of July, 1965

Notary Public

(seal)

My commission expires 7-17-69

APPENDIX D

The following quotations for channels for Instruction Television were furnished by Southwestern Bell Telephone Company on February 10, 1965 and are subject to revision as rate changes occur.

NORTH CIRCLE

A. Based on separate district systems:

		2 Channels	6 Channels
Jennings	- 8 schools	$ 378.25	$ 700.50
Kinloch	- 4 schools	269.50	498.00
Berkeley	- 9 schools	895.75	1465.50
Hazelwood	- 11 schools	1502.25	2356.50
Riverview	- 12 schools	937.75	1573.50
Ferg. - Flor.	- 19 schools	1503.00	2487.00
Total monthly charge all districts		$5486.50	$9081.00

B. Based on above districts operating on circle basis:

	2 Channels	6 Channels
Mileage, 179/4	$3982.75	$5638.50
Input Equipment	80.00	165.00
Output Equipment	868.00	2232.00
Total monthly charge	$4930.75	$8035.50

C. Annual difference if operated on circle basis:

For 2 channel system	$ 6,669.00 less
For 6 channel system	$12,546.00 less

D. Specific advantages in using system leased from the Telephone Company:

- No capitol investment required.

- No FCC licenses required, unlimited channels available.

- Operating costs no more, in many instances less than if school owned.

- Quality performance guaranteed.

- New schools can be easily added.

- Freedom from administrative and technical worries, allows school people to devote their time to teaching duties.

CENTER CIRCLE

A. Based on separate district systems:

		2 Channels	6 Channels
Clayton	- 8 schools	$ 637.00	$1083.00
University City	- 14 schools	988.00	1677.00
Ritenour	- 14 schools	1032.50	1740.00
Normandy	- 10 schools	865.25	1438.50
Wellston	- 4 schools	247.25	466.50
Maplewood-R/H	- 7 schools	488.50	857.00
Brentwood	- 4 schools	269.50	498.00
Ladue	- 13 schools	1218.75	1987.50
Total monthly charge all districts		$5746.75	$9747.50

B. Based on above districts operating on circle basis:

	2 Channels	6 Channels
Mileage, 197/4	$4383.25	$6204.50
Input Equipment	80.00	165.00
Output Equipment	1050.00	2700.00
Total monthly charge	$5513.25	$9069.50

C. Annual difference if operated on circle basis:

For 2 channel system	$2802.00 less
For 6 channel system	$8136.00 less

SOUTH CIRCLE

A. Based on separate district systems:

		2 Channels	6 Channels
Kirkwood	- 15 schools	$1091.00	$1839.00
Webster Groves	- 16 schools	1137.25	1906.50
Affton	- 6schools	453.25	790.50
Lindbergh	- 13 schools	1271.50	2046.00
Hancock	- 3schools	233.25	430.50
Bayless	- 5 schools	211.00	399.00
Mehlville (Includes J.B.)	- 11 schools	1324.25	2104.50
Total monthly charges all districts		$5721.50	$9516.00

B. Based on the 7 districts operating on circle basis:

	2 Channels	6 Channels
Mileage 214/4	$4756.50	$6741.00
Input Equipment	80.00	165.00
Output Equipment	938.00	2412.00
Total monthly charge	$5774.50	$9318.00

C. Annual difference if operated on circle basis:

For 2 channel system	$ 636 more
For 6 channel system	$2376 less

WEST CIRCLE

A. Based on separate district systems:

		2 Channels	6 Channels
Rockwoods	- 12 schools	$2445.00	$3675.00
Valley Park	- 3 schools	94.00	101.00
Parkway	- 11 schools	1710.75	2635.50
Pattonville	- 12 schools	1271.50	2046.00
St. Charles	- 9 schools	695.50	1182.00
Total monthly charges all districts		$6216.75	$9639.50

B. Based on the 6 districts operating as a unit:

	2 Channels	6 Channels
Mileage, 240/4	$5340.00	$7560.00

Input Equipment	80.00	165.00
Output Equipment	588.00	1512.00
Total monthly charge	$6008.00	$9237.00

C. Annual difference if operated on circle basis:

For 2 channel system	$2505.00 less
For 6 channel system	$4830.00 less

COMBINED TOTALS - SUMMARY

A. Based on schools operating on separate district basis:

	2 Channels	6 Channels
North Circle	$ 5,486.50	$ 9,081.00
Center Circle	$ 5,746.75	$ 9,747.50
South Circle	$ 5,721.50	$ 9,516.00
West Circle	$ 6,216.75	$ 9,639.50
Total Monthly charge	$23,171.50	$37,984.00

B. Based on schools operating on circle basis:

	2 Channels	6 Channels
North Circle	$ 4,930.75	$ 8,035.50
Center Circle	$ 5,513.25	$ 9,069.50
South Circle	$ 5,774.50	$ 9,318.00
West Circle	$ 6,008.00	$ 9,237.00
Total monthly charge	$22,226.50	$35,660.00

C. Annual difference if operated on circle basis:

For 2 channel system	$11,340.00 less
For 6 channel system	$27,888.00 less

SPECIAL SCHOOL DISTRICT

Monthly cost to add schools to the network working in their locality:

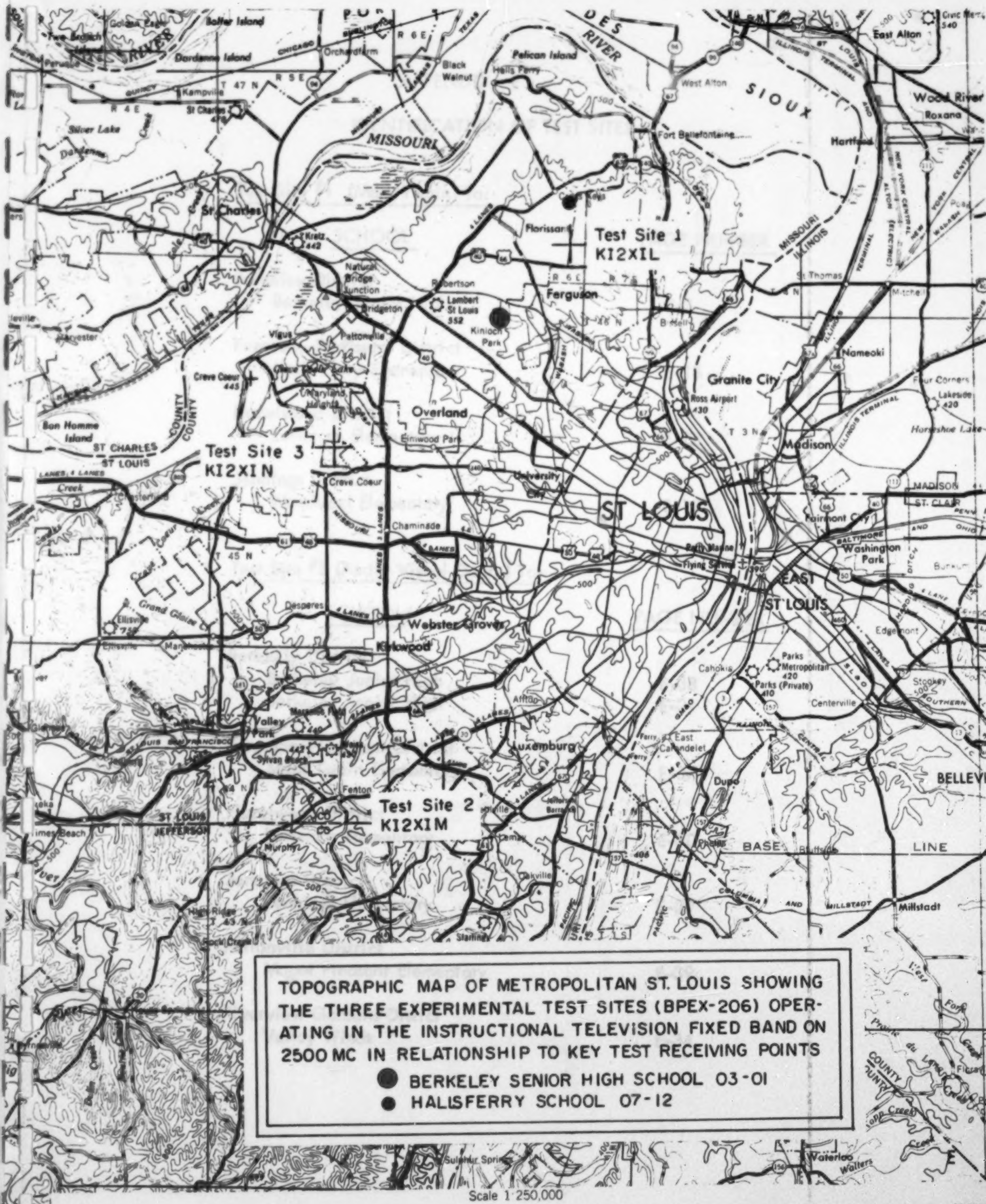
	2 Channels	6 Channels
24-01 Ackerman	$ 36.25	$ 67.50
24-02 Bellevue	36.25	67.50
24-03 Eureka Special	36.25	67.50
24-06 Park	36.25	67.50
24-08 Washington University	58.50	99.00
24-09 West Richmond	36.25	67.50
24-10 Litzsinger Special	36.25	67.50
24-11 Shriners Hospital	80.75	102.75
24-12 Pond	36.25	67.50
25-01 Jefferson Barracks	36.25	67.50
25-02 Lakeside Center	192.00	390.00
25-03 Academy of Science	58.50	99.00
25-04 Technical School	80.75	130.50
Total	$760.50	$1361.25

APPENDIX E

Note: (1) Adding these schools to the network would, in some cases, cause some offsetting of the mileage charges in the district and circle quotations.

(2) To reach Litzsinger for above figures must include installation at Shriners Hospital.

APPENDIX E


Test Site 1
KI2XIL
Test Site 2
KI2XIM
Test Site 3
KI2XIN
ST LOUIS
EAST ST LOUIS
St Charles
Florissant
Ferguson
Granite City
Overland
Webster Groves
Kirkwood
Valley Park
Luxemburg
Fenton
Madison
Belleville
Scale 1:250,000
5
0
5
10
15
20
25 Miles

TOPOGRAPHIC MAP OF METROPOLITAN ST. LOUIS SHOWING THE THREE EXPERIMENTAL TEST SITES (BPEX-206) OPERATING IN THE INSTRUCTIONAL TELEVISION FIXED BAND ON 2500 MC IN RELATIONSHIP TO KEY TEST RECEIVING POINTS

- ● BERKELEY SENIOR HIGH SCHOOL 03-01
- ● HALLSFERRY SCHOOL 07-12

PRECEDING PAGE MISSING

APPENDIX E

IDENTIFICATION OF TEST SITES

Test Site #1 (Mark Twain) To:

SCHOOL	PAGE NUMBER
Berkeley District	
Berkeley Senior High	E-3
Ferguson-Florissant District	
Halls Ferry Elementary	E-13
Hazelwood District	
Larimore Elementary	E-26
Jennings District	
Woodland Elementary	E-18

Test Site #3 (Audio Visual Dept.) To:

SCHOOL	PAGE NUMBER
Berekely District	
Berkeley Junior High	E-38
Berkeley Senior High	E-31
Ferguson-Florissant District	
Mark Twain Elementary	E-37
Hazelwood District	
Larimore Elementary	E-30
Jennings District	
Jennings Elementary	E-29
Pattonville District	
Mount Pleasant Elementary	E-39
Riverview Gardens Distict	
Valley Winds	E-34

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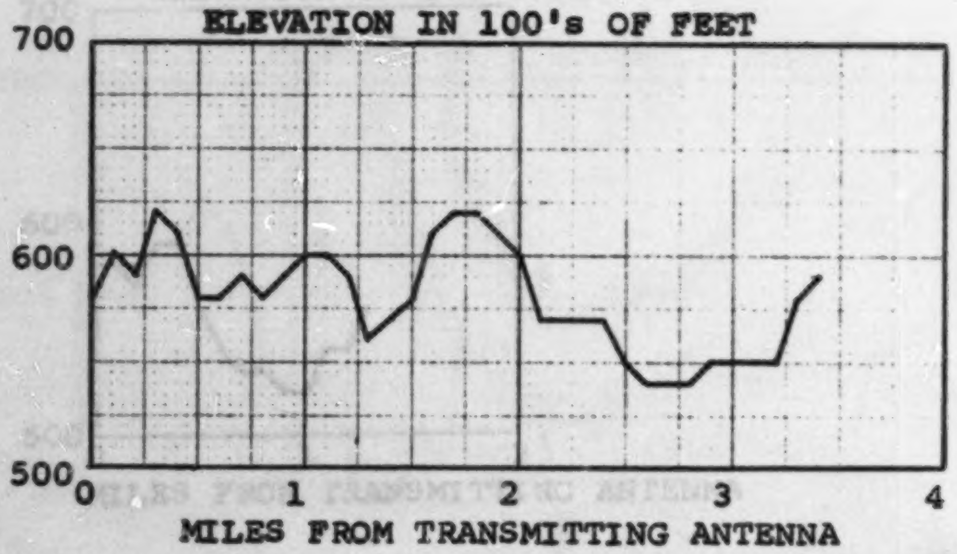

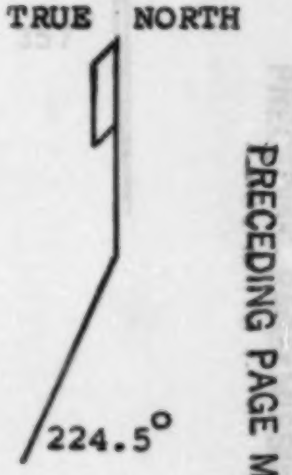

PROFILE DATA FROM TEST SITE #1 AT MARK TWAIN SCHOOL IN FERGUSON-FLORISSANT R-2 TO BERKELEY SENIOR HIGH SCHOOL CODE 03-01

Ralph J. Bitzer, Consulting Radio Engineers, St. Louis, Missouri

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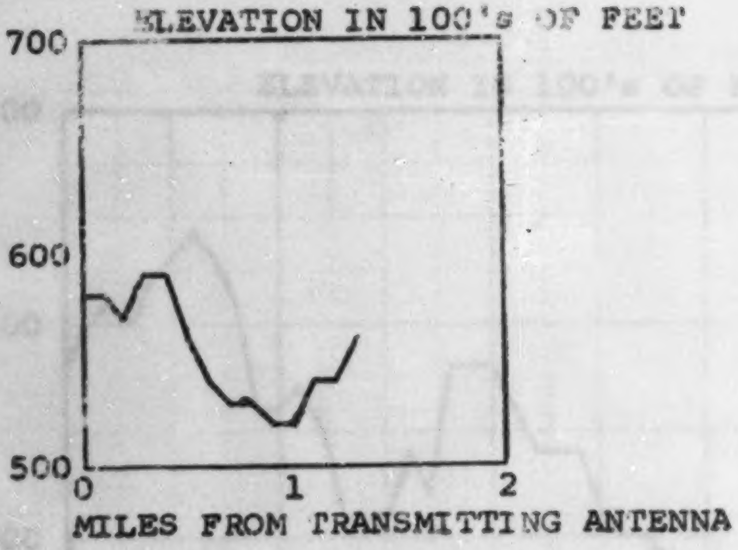

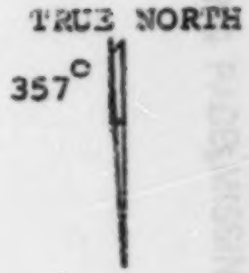

PROFILE DATA FROM TEST SITE #1 AT MARK TWAIN SCHOOL IN FERGUSON-FLORISSANT R-2 TO HALLS FERRY SCHOOL CODE 07-12

Ralph J. Bitzer, Consulting Radio Engineers, St. Louis, Missouri

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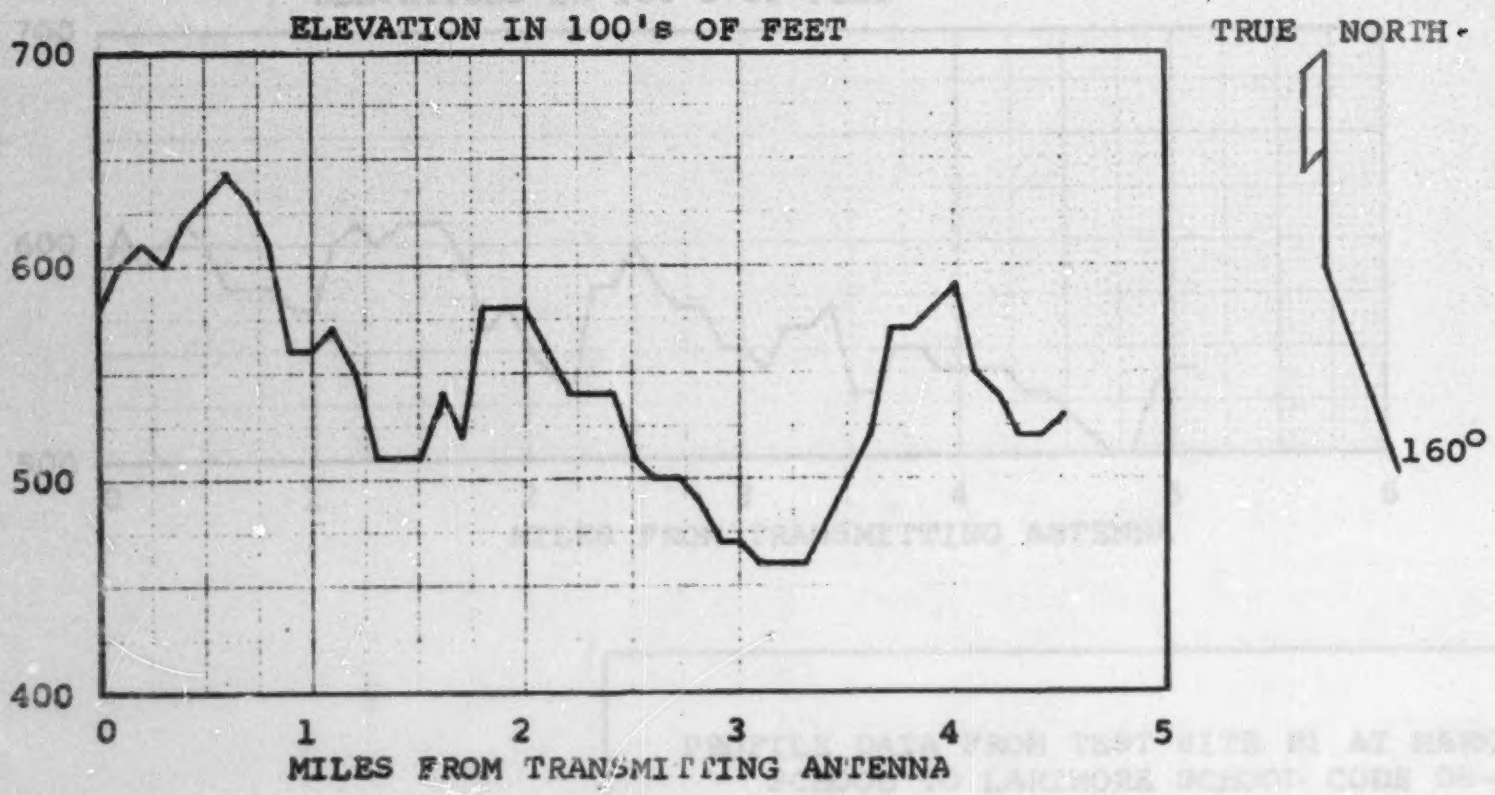

PROFILE DATA FROM TEST SITE #1 AT MARK TWAIN SCHOOL IN FERGUSON-FLORISSANT R-2 TO WOODLAND SCHOOL IN JENNINGS CODE 09-07

Ralph J. Bitzer, Consulting Radio Engineers, St. Louis, Missouri

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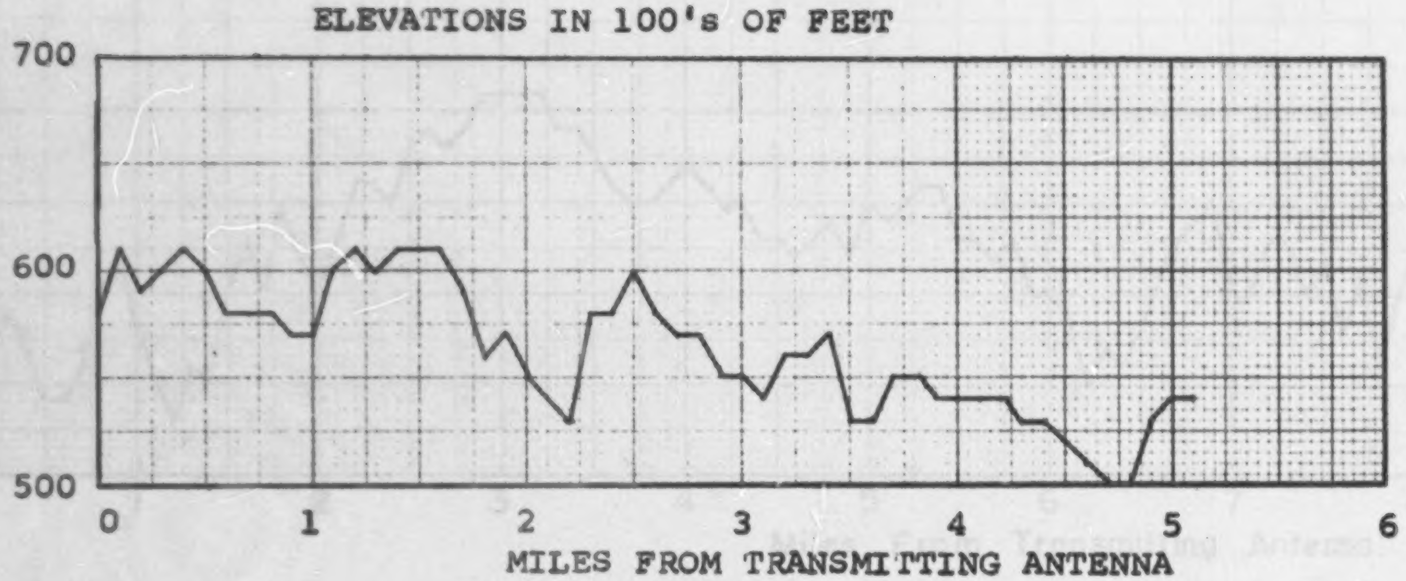

PROFILE DATA FROM TEST SITE #1 AT MARK TWAIN SCHOOL TO LARIMORE SCHOOL CODE 08-06

Ralph J. Bitzer, Consulting Radio Engineers, St. Louis, Missouri

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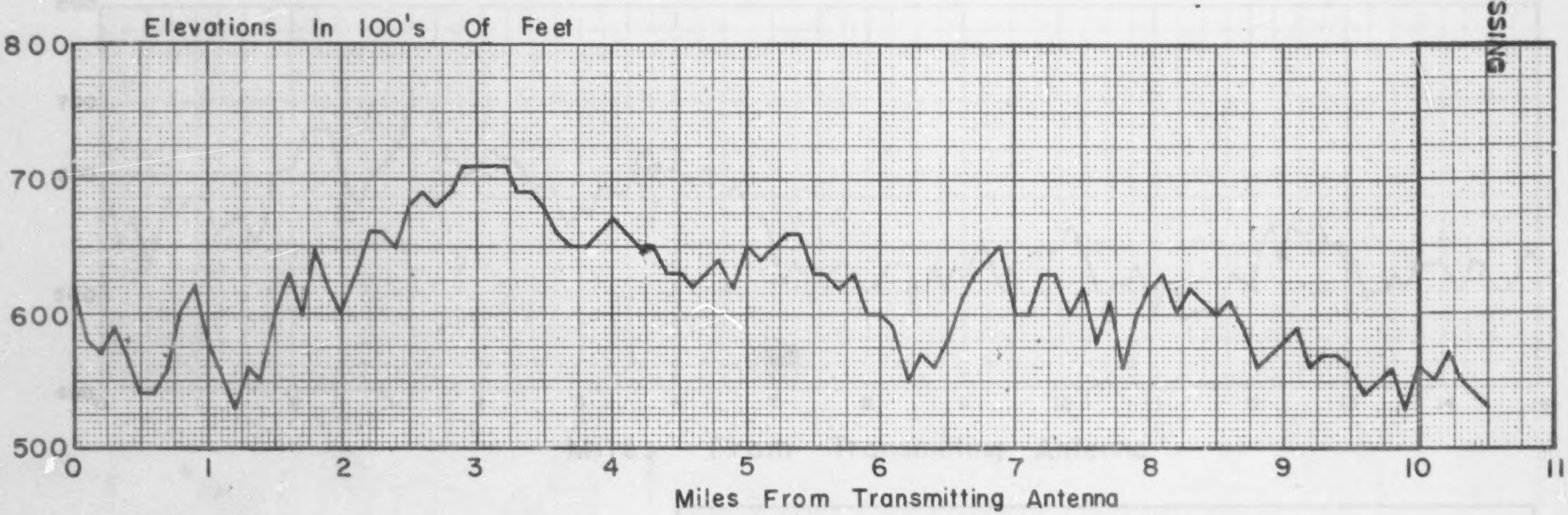
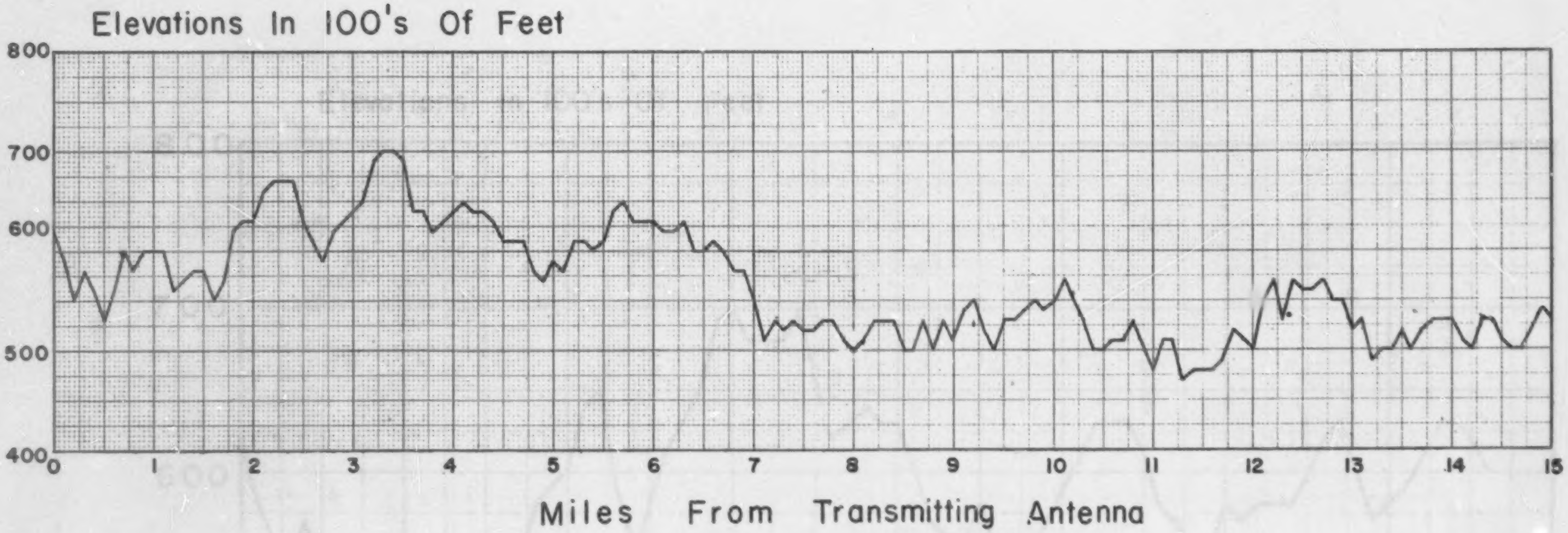


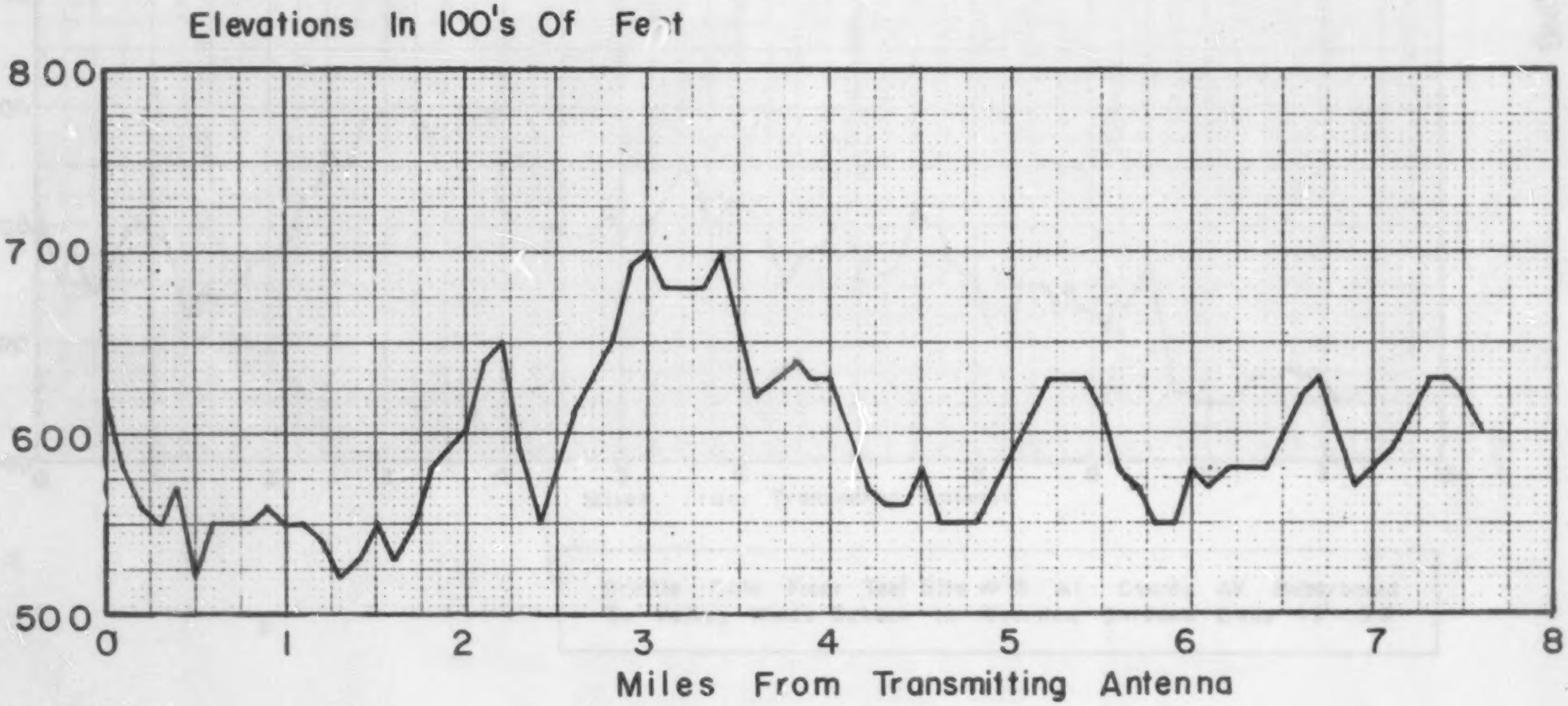
Profile Data From Test Site # 3 At County AV Department To Jennings Elementary School Code 09-06

Ralph J. Bitzer, Consulting Radio Engineers, St. Louis, Missouri



Profile Data From Test Site # 3 At AV Department To Larimore School Code 08–06 In Hazelwood, Missouri

Ralph J. Bitzer, Consulting Radio Engineers, St. Louis, Missouri



Profile Data From Test Site #3 At County AV Department To Berkley Senior High School Code 03-01

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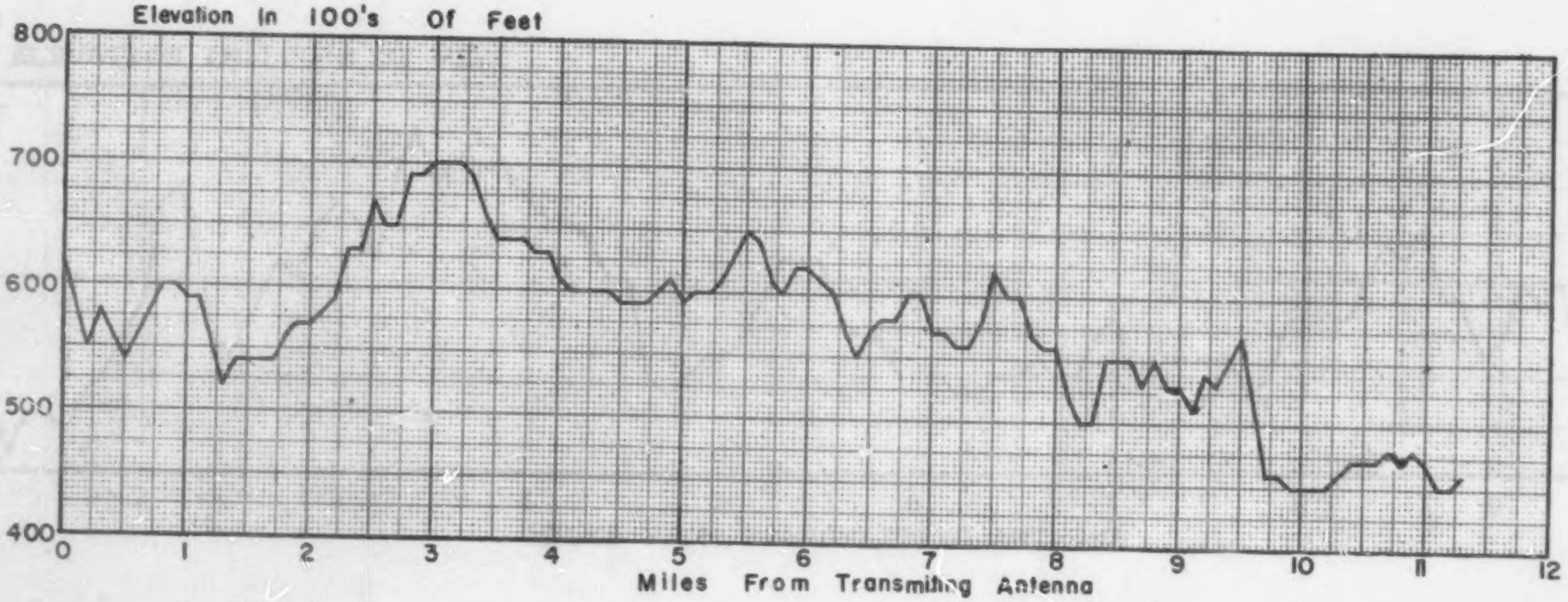
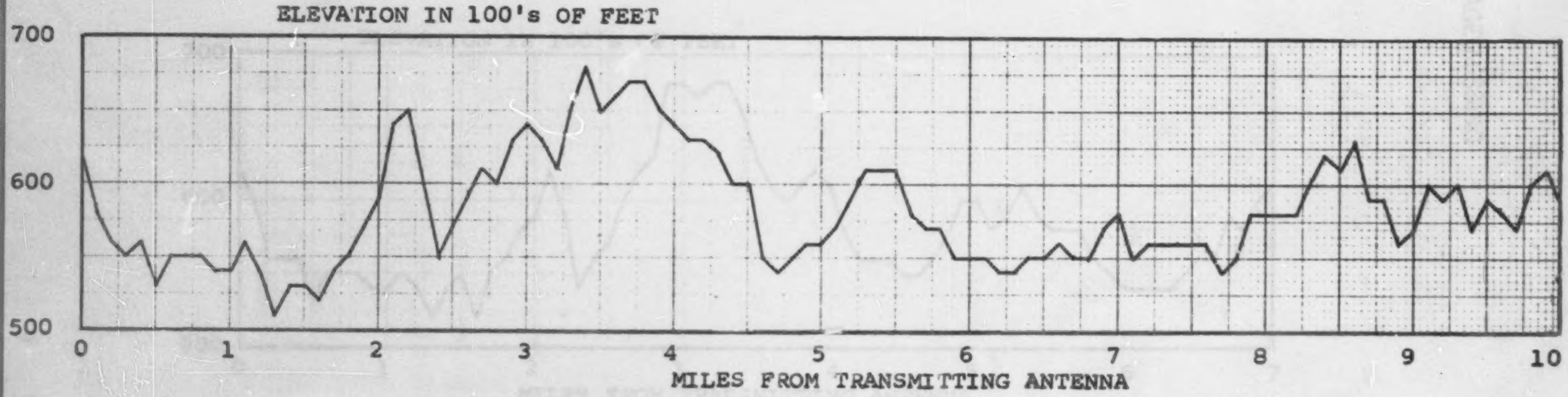


Profile Data From Test Site # 3 At County AV Department
To Valley Winds School In Riverview Gardens Code 19-08

Ralph J. Bitzer, Consulting Radio Engineers, St. Louis, Missouri



PROFILE DATA FROM TEST SITE #3 AT AV DEPARTMENT
TO MARK TWAIN SCHOOL CODE 07-05

Ralph J. Bitzer, Consulting Radio Engineers, St. Louis, Missouri

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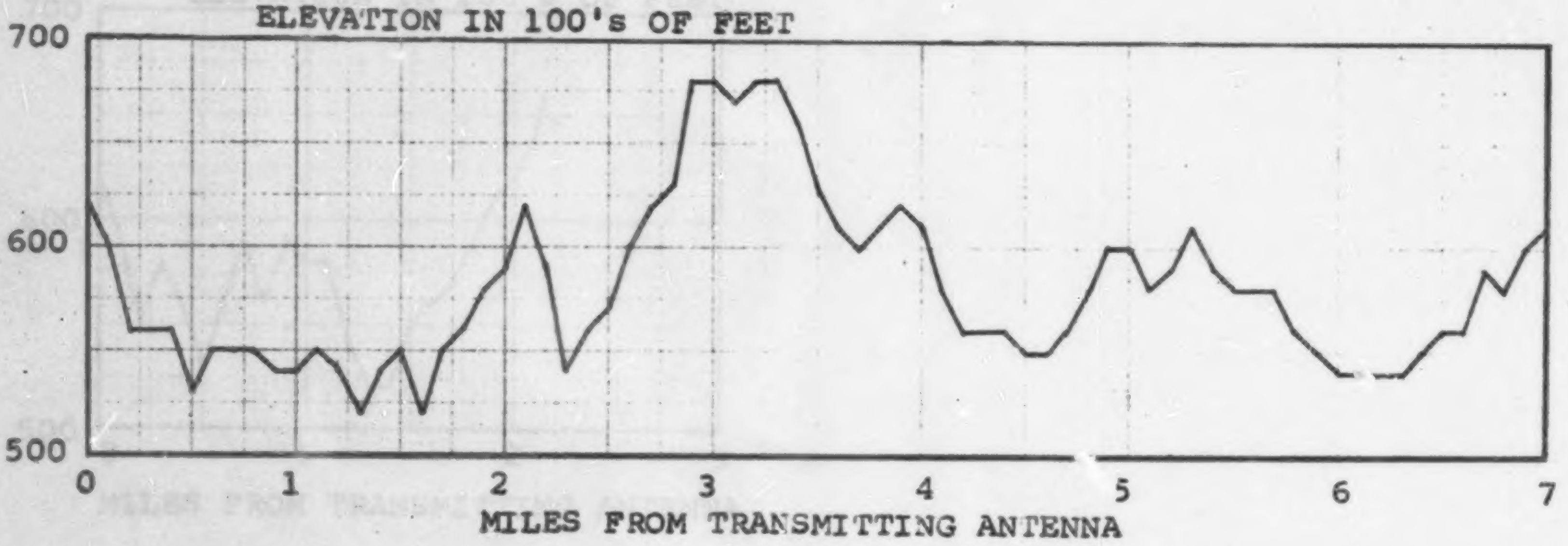
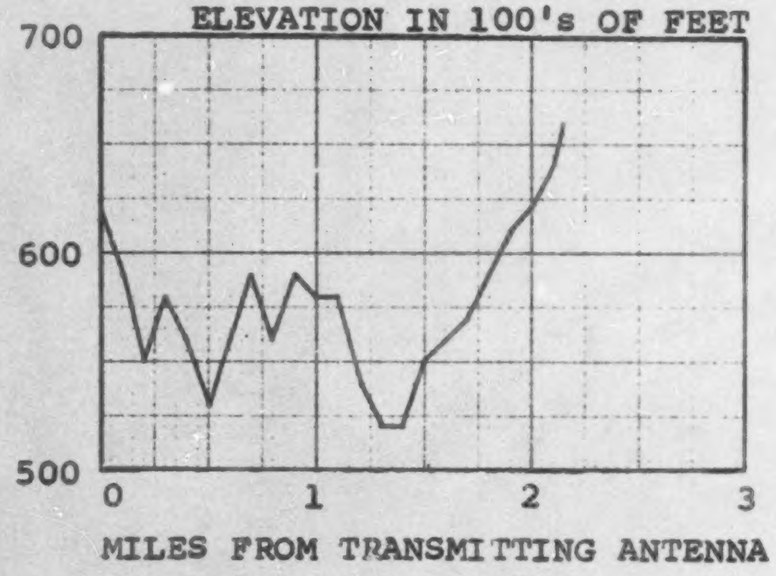


PROFILE DATA FROM TEST SITE #3 AT AV DEPARTMENT
TO BERKLEY JUNIOR HIGH SCHOOL CODE 03-02

Ralph J. Bitzer, Consulting Radio Engineer, St. Louis, Missouri



PROFILE DATA FROM TEST SITE #3 AT AV DEPARTMENT
TO MT. PLEASANT SCHOOL IN PATTONVILLE CODE 17-06

Ralph J. Bitzer, Consulting Radio Engineers, St. Louis, Missouri

APPENDIX F

APPENDIX F

2500 MEGACYCLE INSTRUCTIONAL TELEVISION FIXED SERVICE

File No.	Applicant, permittee, or licensee	Channels	Filed	Granted	Call	On Air
BPIF-1	Plainview Old Bethpage Public Schools Central School Dis. #4, Plainview, Long Island, Dr. Wm Nelligen, New York 11803	2506-2512	1/6/64	2/17/64	KHC94	10/13/64
BPIF-2	Central High School District, No. 2, of the Towns of North Hempstead and Hempstead, New York, Franklin Sq. New York. Mr. Norman Hosler, H. Frank Correy, H.S. 230 Poppy Avenue, Franklin, Squ., N. Y.	2500-2506	1/22/64	3/26/64	KHD 4	11/12/64
BPIF-3	Planedge Union Free School District No. 18, Dalton Levy, Plainedge H. S. Wyngate Dr., No. Massepequa, New York, 11761	2554-2460	1/31/64	5/21/64	KNU40	11/12/64
BPIF-4	Parma Board of Education, Paul Briggs, Supt. of Schools, 6726 Ridge Road, Parma, Ohio	A1	5/17/64	6/26/64	KNZ60	9/28/64
BPIF-5	The Archdiocese of New York c/o 253 Sunrise Highway, Rockville Center, Long Island, New York; Rev. Edgar McCarren (For: Rockville Center, L. I., New York)	E1,2,3,4	6/1/64	7/28/64	KNZ65	
BPIF-6	See BPIF 5 (For Roslyn Heights, New York)	C1,2,3,4	6/1/64	7/28/64	KNZ66	

FILE NO.	Applicant, permittee, or licensee	Channels	Filed	Granted	Call	On Air
BPIF - 7	See BPIF 5 (For New Huntington, New York)	G1,2,3,4	6/1/64	7/28/64	KNZ67	
BPIF - 8	See BPIF 5 (For Central Islip, New York)	D1,2,3,4	6/1/64	7/28/64	KNZ68	
BPIF - 9	Roman Catholic Diocese of Brooklyn, New York) 75 Greene Ave., Brooklyn, N. Y., Eugene Malloy	F1,2,3,4 To: B1,2,3,4	6/5/64 7/9/64	7/28/64 7/28/64	KNZ69	
BPIF-10	See BPIF 9 For Jamaica, Brooklyn, New York	C1,2,3,4 To F1,2,3,4	6/5/64 7/9/64	7/28/64 7/28/64	KNZ70	
BPIF-11	Union Free School District #10 of the Town of North Hempstead Mineola, N. Y. Dr. Ben Wallace 200 Emory Road., Mineola, N.Y.	G1,2	6/1/64	7/28/64	KNZ71	Yes
BPIF-12	Coleman F. Carroll, Bishop of the Diocese of Miami, Miami, Fla.	A1,2,3,4 E1 (10w)	8/19/64	12/16/64		
BPIF-13	William McKeener, 6301 Biscayne Miami, Fla. Filed by BPIF-12 for St. Gregory School, Frt. Lauderdale	C1,2,3,4 G1 (10w)	8/19/64	12/16/64		
BPIF-14	Wm. McKeener, 6301 Biscayne Miami, Florida. Filed by BPIF-12 for St. Vincent Ferrer School, Delray Beach, Florida	A1,2,3,4 E1	8/19/64	12/16,64		
BPIF-15	Wm. Mckeener, 6301 Biscayne Miami, Fla. Filed by BPIF-12 for St. Francis of Assissi School, River Beach, Florida	G1,2,3,4	8/19/64	12/16/64		

BPIF-16	Rt, Rev, Msgr. Leonard Hunt, 451 Madison Ave., N.Y. Archdiocese of New York.	A1,2,3 (10w)	8/19/64	1/29/64
BPIF-17	Rt. Rev. Msgr. Leonard Hunt, 451 Madison Ave., N.Y. for St. Francis Seminary, Staten Island	E1,2,3 (10w)	8/19/64	1/29/65
BPIF-18	Rt. Rev. Msgr. Leonard Hunt, 451 Maidson Ave., N. Y. Archdiocese of N. Y. Dunwoodie, Yonkers, N. Y.	E1,2,3 (10w)	8/19/64	1/29/65
BPIF-19	Rt. Rev. Msgr. Leonard Hunt, 451 Madison Ave., N.Y. Archdiocese of N. Y. Peekskill, N.Y.	A1,2,3 (10w)	8/19/64	1/29/65
BPIF-20	Rt. Rev., Msgr. Leonard Hunt, 451 Madison Ave., New York Archdiocese of Ne. Y. Beacon, N. Y.	E1,2,3 (10w)	8/19/64	1/29/65
BPIF-21	Rt. Rev. Msgr. Leonard Hunt, 451 Madison Ave., N. Y. Archdiocese of New York near Liberty, N. Y.	A1,2,3 (10w)	8/19/64	
BPIF-22	Rt. Rev. Msgr. Leonard Hunt, 451 Madison Ave., N. Y. Archdiocese of New York, Kingston, N. Y.	A1,2,3 (10w)	8/19/64	1/29/65
BPIF-23	Rev. Manuel Roman, 330 N. Charles St. Baltimore, Md. Roman Catholic Archbishop of Baltimore, Maryland	A1,2,3 (10w)	9/10/64	12/29/64
BPIF-24	Central High, Dist. #2 of Mad. Town of Hempstead, (to add 2nd transmitter	A2	9/16/64	12/22/64

BPIF-25	Board of Edu., Township High School Dis. #203, Cook County Ill. L.C. Goodrick, 385 Winnetka	A1,2,3,4	9/2//64	3/10/65	KGZ66
BPIF-26	Archdiocese of Los Angeles, Edu. & Welfare Corp., Rev. John C. Urban 1531 W. 93rd, St. Los. Angeles, Cal.	A1,2,3,4	9/25/64		
BPIF-27	" " " " " "	E1,2,3,4	9/25/64 .		
BPIF-28	City School Dis. of Rochester, N.Y. Arthur Growdery, Jr., 13 S. Fitzhugh St., Rochester, New York	D1	10/21/64	3/11/65	KRV45
BPIF-29	Rio School Dist., 3300 Cortez, St., Oxnard, Cal. Joseph Hague	A1	12/10/64	2/19/65	KRU33
BPIF-30	Archdiocese of Los Angeles & Edu. & Welfare Corp., 1531 W. 93rd Los Angeles, California, Rev. John C. Urban	C1,2,3,4	11/5/64		
BPIF-31	Archdiocese of Detroit, 1234 Washington, Detroit, Michigan, Rev. Dennis Harrety	A1			
BPIF-32	Plainedge Union Free School Dist. #18 (See BPIF 3 for address)	Add 3 Tx & D2,3,4	2/23/65		
BPIF-33	School Branch Independant School Dist. Houston, Texas	D1,2	2/23/65	4/21/65	KRZ68
BPIF-34	Regents of Univ. of Cal. Medical Center, San Francisco, California	F4 (10w)	3/16/65	7/14/65	KTB97
BPIF-35	Board of Public Instruction of Dade County, Florida	F1,2,3,4	3/18/65	6/18/65	KTB84
BPIF-36	Board of Public Instruction of Dade County, Florida	C1,2,3,4	3/18,65	6/18/65	KTB85

BPIF-37	Board of Edu., City of Detroit, Detroit, Michigan	2560-2566 2572-2578 (20 watts)	4/9/65	
BPIF-38	City School Dist. of Newburgh Newburgh, N. Y.	D1,2 (10w)	4/27/65	
BPIF-39	Central High School Dist. #2 Hempstead & N. Hempstead, N. Y.	A1,2,3 (10w)	5/5/65	KHD-21
BPIF-40	Board of Pub. Instruction Fort Lauderdale, Florida	G1,2,3,4 (10w)	5/19/65	
BPIF-41	Bishop of the Diocese of St. Augustine, Jacksonville, Fla.	G1,2,3,4 (10w)	5/27/65	
BPIF-42	Bishop of the Diocese of St. Augustine, Tampa, Fla.	G1,2,3,4 (10w)	5/27/65	
BPIF-43	Bishop of the Diocese of St. Augustine, St. Petersburg, Fla.	A1,2,3,4 (10w)	5/27/65	
BPIF-44	Bishop of the Diocese of St. Augustine, Orlando, Fla.	A1,2,3,4 (10w)	5/27/65	
BPIF-	Diocese of Cleveland, Akron. Ohio	G1,2,3,4		
BPIF-	Diocese of Cleveland, Beechwood, Ohio	G1,2,3,4		
BPIF-	Diocese of Cleveland, Chardon, Ohio	E1,2,3,4		
BPIF-	Diocese of Cleveland, N. Ridgeville, Ohio	C1,2,3,4		
BPIF-	Diocese of Cleveland, Parma Ohio	E1,2,3,4		

APPENDIX G

APPENDIX G

MANUFACTURERS, CLOSED AND OPEN-CIRCUIT TELEVISION INSTALLATIONS FURNISHING DATA FOR PHASE A REPORT

1. Companies with whose representatives this research staff has had significant conversations related to this project.

Adler Electronics
Ampex Corporation
Dage Television Company
Emcee, Inc.
Fairchild Industrial Products
IBM- International Business Machines
Jerrold Electronics Corporation
Magnavox Television Corporation
Medicom, Inc.
Microlink
Norelco, North American Phillips Co.
Sony Corporation of America
Southwestern Bell Telephone
Video Systems, Inc.
Watland Incorporated
Xerox Corporation
Bell Research Laboratories
Coronet Films
Encyclopaedia Brittanica Films
FAA- Federal Aviation Agency
Federal Communication Commission
General Precisions Laboratories
Henk Newenhouse
Lowe- Opta
Machtonics
3M- Minnesota Mining & Manufacturing
McGraw Hill Text Films
RCA - Radio Corporation of America
Sylvania Electric Products, Inc.
Traid Corporation
Video Medical Products

2. Installations of open or closed circuit television visited and observed during the contract period June 1964-September 1965.

Air Force Academy, Colorado Springs, Colorado
Anaheim, California
Bayless School District, St. Louis County
Bell Exhibit, World's Fair, New York City, New York
Byrd School, Chicago, Illinois
Great Lakes Naval Training Center - Chicago, Illinois
North Chicago Teachers College - Chicago, Illinois
Northern Illinois University - De Kalb, Illinois
Ohio State University - Columbus, Ohio
Plainview, Old Bethpage, New York, New York
South Carolina State TV Network - Columbia, South Carolina
Suwaneka, New York, New York
Washington County, Maryland

MANUFACTURERS, CLOSED AND OPEN-CIRCUIT TELEVISION INSTALLATIONS FURNISHING DATA FOR PHASE A REPORT (continued)

3. Installations of open or closed circuit television visited and observed by staff members prior to the contract period.

ABC, St. Louis
CBS, Chicago
CBS, St. Louis
Dade County, Florida
Denver Public Schools, Denver, Colorado
East High School, Rochester, New York
Kansas City Public Schools, Kansas City, Missouri
KOMU, Columbia, Missouri
KYTV, Springfield, Missouri
Lackland Air Force Base, Lackland Texas
Milwaukee Public Schools, Milwaukee, Wisconsin
Missouri University, Columbia, Missouri
MPATI
NBC, New York
Oklahoma City Public Schools, Oklahoma City, Oklahoma
Southern Illinois University, Carbondale, Illinois
Stephens College, Columbia, Missouri
St. Louis Educational Television Station

APPENDIX H

APPENDIX H

NORTH CIRCLE PILOT PROJECT 2500 MC - TESTING PROGRAM

DAILY LOG

KI2XIN - KI2XIM - KI2XIL

DATE June 1, 1965 LOCATION Creve Coeur, Missouri

TRANSMITTER FREQUENCY 25.48 MC

TIME	REMARKS	PROGRAM	OPERATOR ON DUTY
on 8:10	Test Pattern - Music Station ID		Cody
9:05	Teacher - McCallister (27 students)	"Home on the Range" F50667	Cody
9:40	Teacher - Kieninger (27 students)	"Drawing with a Pencil" F50392	Cody
9:50	Station ID		
9:55	Teacher - Kieninger (27 students)	"Finger Painting" F50504	Cody
10:40	Teacher - Kieninger (27 students)	"Drawing with a Pencil" F50392	Cody
11:00	Teacher - Bolton (27 students)	"Let's Visit St Louis Zoo" F50861	Cody
11:17	Teacher - Bolton (27 students)	"let's Visit St. Louis Art Museum" F50859	Cody
12:19	Station Identification		
12:20	Teacher - Bates (29 students)	"Meaning of Long Division" F50963	Mitchell
12:35	Teacher - Bates (29 students)	"Decimal Fractions" F50361	Mitchell
1:30	Teacher - Struemagel (37 students)	"Mother Goose" F50032	Mitchell
1:40	Teacher - Struemagel (37 students)	"Our Family Works Together" F51147	Mitchell
1:45	Station Identification		
2:15	Teacher - Armentrout (29 students)	"Symphony Orchestra" F51490	Cody
2:45	Teacher - Vincent (29 students)	"Let's Play Save" F50856	Cody

TIME	REMARKS	PROGRAM	OPERATOR ON DUTY
2:55	Teacher - Vincent (29 students)	"Safety on the Street" F51333	Cody
3:00	Test Pattern - Music		Cody
4:35	Sign off Station Identification Music		Cody

APPENDIX I

APPENDIX

FOLLOWING ARE COMMENTARIES FROM MEDIA DISTRIBUTION CONSULTANTS FOR PHASE A OF THIS PROJECT. PHASE B IS PARTIALLY BASED UPON THEIR RECOMMENDATIONS:

June 14, 1965

Mr. Virgil C. McCluer
Principal Investigator
North Circle Pilot Project
655 January Avenue
Ferguson 35, Missouri

Dear Mr. McCluer:

I apologize for being so very, very late in thanking you and your staff for the opportunity of visiting the North Circle Project as a Consultant. I feel that I contributed relatively little, but I do know that I learned much and it was a most challenging experience. You and your staff are to be congratulated on the vision and courage that you have shown in undertaking this experimentation. As you said in your letter of May 24, you have certainly opened up a very wide spectrum of problems and possibilities.

I am intrigued with the possibilities of a dual purpose closed-circuit television system via 2500 megacycle. Many school systems, when they introduce a CCTV system beyond one building are plagued with the problem of how to do a sufficient amount of good programing to justify the expense in the system. Your plan would allow you to use this facility as a distribution system alongside your closed-circuit programing, while it is being developed to the peak of its potential. This, in my opinion, is the unique feature of your experiment.

It seems that the first phase of your project is well under way and by fall, or perhaps by Christmas at the latest, you will have tested the 2500 mg equipment and signals. You will be able to report about the fidelity of the system, initial costs factors, effects of terrain on the message transmission, and similar problems. There are others better qualified to comment on this aspect of your program than I.

Before the close of this phase, I hope that you can be under way in what I think is an equally important phase and that will involve a study of what happens when you offer this kind of a distribution service for stored audio-visual messages (films, recordings, etc.) to schools. Here I think it is important that you take both sample elementary and secondary schools, large and small, and you will need also to select schools on which you have records of the use of audiovisual materials the previous year so that you can study what happens to the quantity and the quality of use and also what is the acceptance of teachers and students.

Such tests should run a minimum of one semester and one year, I think, would be preferrable because you may find that the use shoots up and then drops off or vice versa. What you need to be able to predict is about where the use figure will level off to in an elementary and secondary school.

Such a study would also give you an opportunity to find out what logistic problems you run into in trying to meet requests on demand. At what point does it become necessary to prerecord in a building on, say, video-tape recorders? Do you soon run into the problem of unavailability of materials not because the print isn't on hand to send to a school, but other school have requested it at the same time and it is being transmitted to them? Perhaps you can even make some estimates about the size of an operation before it would be economically and logistically feasible to decentralize, that is to break your service, into two smaller units to duplicate facilities, that is.

At the same time such a study is going on, you could be building up the work of your curriculum committee and turning some of their ideas into programing concepts for use of your closed-circuit facility.

I am not going to comment on the homework assignment originally given us because I think perhaps toward the close of our meeting you were thinking of decentralizing this problem, or at least getting a small study that would delve into what organizations and what people have the kind of information which you requested us to send into you as the homework assignment and which we agreed no one of us would be equal to. If I'm incorrect on this, then there are a few of these fourteen or fifteen points on which I might have a little information.

Thank you again for a very challenging experience and do keep me informed as to what progress and plans you are making for the future.

Sincerely yours,

Anna L. Hyer
Executive Secretary
NEA
Dept. of Audiovisual Instruction
1201 Sixteenth Street, N.W.
Washington, D. C.

May 14, 1965

Mr. Virgil C. McCluer
Principal Investigator
North Circle Pilot Project
655 January Avenue
Ferguson 35, Missouri

Dear Mr. McCluer:

This is a report in connection with consulting with you and your staff relative to the North Circle Project. The time spent with you was profitable for us and I hope the contributions we tried to make were of some value. The planning and thoughtfulness of you and your staff was appreciated.

As I understand the project it is to develop a multipurpose closed circuit television system which could play a role in the production and distribution of instructional materials.

What we consulted on were some of the physical aspects of the 2500 megacycle system which you had assembled, the suggested uses for such a system and the discussion relative to the many facets of the study. May I say, at this point, that I was impressed with the work of your committee, Paul Andereck, Don Mitchell and Warren Boecklen and the members of the Cooperating School Districts. The spirit of the committee and the willingness to support financially cooperative projects indicate that you have the necessary support for successful educational programs.

As the discussions took place and the actual progress in setting the 2500 megacycle equipment became known it seemed apparent that the size of the project was larger than you could complete in the time alloted to you. The progress you have made is probably more than actually should be expected. It seemed that many extra hours were spent in connection with the progress to date.

You have what I would call Phase A well underway. You are testing the 2500 megacycle equipment and signals, you have a curriculum committee examining problems involved in the utilization of electronic transmission devices, you have interest in and support for the concepts of distribution of materials and systems design. These are the fronts on which you need to continue work.

It is now suggested that you enter another phase, Phase B, let's say, which would include the following:

1. Continue testing the signals and equipment

2. Secure interested persons in the North Circle Area who are willing to do some research on who know what and how much do they know relative to computer cataloging, ordering from a computer, copyright problems, print outs of all

kinds, storage and retrieval of information, and the proposed nature information might take five, ten, twenty years from now.

3. Continue the investigation as to how television and related distribution systems can aid instruction. What effects would these systems have on the current content and methods of instruction? Are you adding a significant dimension to the teaching learning process? Don't get involved in academic arguments such as films versus television or direct instruction versus enrichment as the evidence seems to indicate that you need all kinds of experiences for students.

4. Explore, with your committees, during the 1965-66 school year both aspects of the project. Produce and use television programs. Give the teachers something to which they and their students can react. Find out what happens in the classrooms. Check the relationships with the broadcast channels in your area. Secure information on what conditions affect signals. Experiment with selected schools in the distributing of such things as films, filmstrips, slides, and charts via 2500 megacycles to try to determine what demands you can expect, what messages are usable, what support system is needed, at what point, if any, will it not work, how many channels would a workable system need, what are costs, on some unit basis, that can be used as an administrative tool for budgets.

If such a program can be staffed and budgeted, the information would be of great value to school systems across the nation.

I would suggest postponing for a year total financing research, certain other technical investigations, large scale experimenting and elaborate data processing scheme to give yourselves time to work out Phase B. If you can do this, Phase B will give further direction. Perhaps at this point others may be available to help expand and carry out needed research.

I hope these thoughts are of some value to you. Again I wish to say thank you for inviting me to participate.

Cordially yours,

Robert C. Gerletti, Director
Division of Audio-Visual Education
County of Los Angeles
Superintendent of Schools
155 West Washington Blvd.
Los Angeles, California

June 7, 1965

Mr. Paul Andereck
North Circle Project
Audio-Visual Education Center
St. Louis County School Districts
St. Louis, Missouri

Dear Paul:

It has taken me far too long to gather my wits, first to thank you for the chance to be with you all on the 10th and 11th of May and second to offer you some observations. We've been fighting to get an appropriation for an open circuit station here in Columbia, and I could not turn my mind to other things. Incidentally, we are going to get Channel 31.

Your proposal for a communications system to attack the logistics of supplying teachers with every kind of electronic resource is over-poweringly imaginative. Such a system carried to its ultimate development with instant ordering, computerized storage and retrieval and all the other elements would be the answer to an audio-visual man's prayer. I hope you will keep hammering away at it because I know deep down in my bones that you are on the right track. The hardware necessary to do it is on the way or will be in the near future.

In that connection, have you ever talked to any IBM people about your project? They are pushing along on computer teaching, and there must be ways in which what you have conceived would jibe with what they are working at.

Before your dreams can become a reality, however, the profession you want to serve will have to make some new commitments. Teachers aren't ready yet for what you have to offer them; they do not plan far enough ahead to know what they will want from such a system. And they will have to become much more aware of what you have to offer than even a catalog can tell them. They have been trained to operate a self-contained class-room and they do not know how to be a manager of resources.

The chief virtue in getting curriculum building efforts going is that it will insure that teachers look beyond themselves as sources of instruction. Until they begin to reach out, not so much for help but for extending what they can offer pupils, then don't see any problem in logistics, and your solution has no meaning for them. All too many of them are quite certain that they have already all the medicine they need to prescribe right at their fingertips. You offer them more medicine than they know how to use.

Until you or someone else gets the teachers to the point where they are demanding more instructional resources than they can get and have convinced them that they must have these resources or they are not fulfilling their professional obligations, they will not understand the need for your proposed system and will look upon it as an intrusion.

Teachers do not yet know how to use the textbook; if they did, publishers could quit printing teacher's editions and could get out of the consultant business. Until we get a new breed of cat in the classroom all of us who want to give them resources which they don't feel they need are in for some real frustrations.

Once again, however, let me urge you to continue your drive to provide a system which will lessen the problems of logistics once the profession is ready to use it. In the meantime, get somebody working on that profession to convince it that it has a problem for which you have the possibility for solution.

Yours truly

APPENDIX

George E. Bair
Education Director
ETV
South Carolina Edu. TV Center
2712 Millwood Avenue
Columbia, South Carolina

APPENDIX J

"NEW LOGISTICAL PATTERNS FOR MATERIALS CENTERS"

by Paul Andereck

Audio Visual Director of the Cooperating School
Districts of the St. Louis Suburban Area

The director of an instructional materials center does not dictate curriculum. He responds to others. The director of an instructional materials center does not dictate financial decisions. Boards of education or the general clientele of a materials center usually control the financial framework in which the materials center operates. But in the area of logistics, the director of a materials center is usually given the responsibility of establishing a system of storage, transporting of materials, ordering, and the like. Logistics is the art of working out the large and small details of housing materials and transporting those materials to the troops out in the field. It stands to reason that those whose jobs require setting up, operating and revising logistical patterns for materials centers must be familiar with technological developments related to their field of specialty. The position of audio visual director demands that we keep one eye on what we are now doing and one on what we might be doing. How long has it been since you have examined your logistical patterns to see if there are better ways of doing what you are now doing. I don't mean superficial changes....we make those daily. I don't mean minor changes which solve minor problems. I mean, when have you looked at the basic processes upon which your material center depends?

I have divided the logistical elements of a materials center into ten phases. Let's examine a materials-center in terms of these ten phases and see if there aren't better ways of doing what we are now trying to do. Remember what we are trying to do: Have WHAT is useful in the hands of the teacher WHEN it is useful.

The ten headings I have made are:

> SCOPE, SOURCE, STORAGE FORM, CATALOGING, ORDERING, PREPARATION FOR SHIPMENT, DELIVERY MODE, DISPLAY FORM, RETURN MODE, and IN-PROCESSING

Let me explain each heading: "Scope" refers to the kinds of materials stored in the materials center. Do you have films? filmstrips? records? What is the scope of materials in the center? "Source" refers to the origin of these materials. Do you buy them all from producers? Do you have local production facilities? What is your source for the materials you stock? "Storage form" refers to the way they are shelved. Do you shelve things in their natural state? That is, are films stored as films and records as records and pictures as pictures? Or do you convert them? Conceivably, the films might be copied on videotape, the records might be stored as tape recordings and the pictures might be stored on micro-film. "Cataloging" refers to the means by which your inventory is organized and publicized to the teachers. Do you use a card catalog? Or a book-type catalog? By what means do you inform the user of what you have in stock? "Ordering" refers to the process for receiving requests. "Preparation for shipment" refers to the internal processes required for getting an order ready for delivery. Do you pick materials off the shelves and load them in shipping containers? Do you put them on recorders to send them by television? Do you copy your master tapes onto the teacher's tapes? How do you ready an order? "Delivery mode" refers to the transporting from the center to the using teacher. Do you send your materials by truck? By television? By U.S. Mail? What is your mode of delivering materials? "Display form" refers to the means by which the material is presented to the learner. Do you project them on a screen? Does the learner view the material, directly, without use of machinery? Does he have the materials presented to him by headphones? By what means is the materials displayed? "Return mode" refers to the method by which the materials get back to your depository. Does the teacher carry the material back by auto? Do the teachers mail them back? Is the material returned at all (no return is necessary for television or radio materials). And "in-processing" refers to those steps required for reshelving materials. Do you inspect materials? Are they cleaned or rewound? What things must you do in getting the incoming materials ready for the next customer?

This list of ten phases exists in virtually all materials systems, whether we're talking about systems operated by schools, districts, counties, or states. They are part of film libraries, book libraries and educational television stations. Working out the processes used in each phase is actually the main responsibility of a materials-center director.

Of course, different types of materials require different handling. Tapes might be delivered by radio, while films might be delivered by truck, and filmstrips might be delivered by customer pickup. . . all in one and the same materials center. To account for the different procedures required for different kinds of materials, let's say that we have three sub-systems making up our materials distribution system: The first sub-system is that used for handling materials having both sound and motion. The "motion and sound" sub-system could handle films and videotapes. The second sub-system is that used for materials having no motion and no sound. The "still picture" sub-system"could handle filmstrips, slides, charts, pictures, and the like. The third one is "audio only" a sub-system for handling records, tapes, and any other kind of non-pictorial materials.

Now, let's layout the ten phases and three sub-systems in chart form. I call this a decision table. By heading ten columns with teh ten phases and providing three lines for the three sub-systems we can plot the total system for a materials-center.

Let's list the ALTERNATE ways by which each step might be accomplished. You could have 8 mm films, 16 mm films, kinescopes and several varieties of videotapes. You can purchase, lease, rent, or produce your own by television or film techniques. You can store in natural state or convert every thing to film or convert everything to videotape. You can use a card-catalog, book-type catalog, the shelf-labels might be the only catalog, or a computer might be the catalog. You can use people and paper for ordering, dataphone and data-processing equipment for ordering or variations of the human and machine techniques. You can prepare for shipment by loading sacks, wrapping packages, loading videotape recorders or loading film chains.

You can deliver by mail, truck, customer pickup, open circuit TV, closed-circuit cabled TV, microwaved TV or 2500 megacycle TV. You can display to learner by projector and screen, or television screen or projection TV. You can return materials by truck, mail, customer walk-in, or not at all. You can in-process by rewinding, inspecting, cleaning, shelving, or all four steps.

You could have a still picture sub-system whose scope includes, filmstrips, slides, transparencies photos, microfilm, charts, maps, drawings, tests, book pages, or programed instruction materials. They can be purchased or locally prepared by printing facilities, graphics facilities or photo facilities. They might be stored in natural state, converted to paper prints, converted to microfilm, converted to disc video recordings, or converted to regular videotape. The same variety of cataloging and ordering techniques could be employed as those we listed for the motion and sound sub-system. The still materials could be prepared for shipment by packaging or machine loading. Still materials can be delivered by mail, truck, slow scan television on regular telephone cables, cabled closed-circuit television, 2500 megacycle television, wirephoto, dataphone, microwaved television, or customer pickup. They can be displayed to the learner by direct viewing, projection, television screen, microfilm reader or slide viewer. They can be returned and in-processed by the same techniques described earlier for sound and motion materials.

Audio materials might include phonograph records and magnetic tape recordings. They can be purchased or locally prepared in classrooms or a studio. They can be stored in natural state or all converted to magnetic tapes (either cartridge or reel-to-reel). Audio materials can be cataloged and ordered by the same techniques as other materials. You can prepare audio materials for shipment by packaging or loading audio recorders. You can deliver audio material by truck, by mail, customer pickup, AM radio, FM radio, multiplexed FM radio, telephone lines, or the audio portion of a television signal. They can be displayed to the learner by loudspeaker or headphones. They can be returned and in-processed by the same means mentioned earlier.

As rapidly as possible, I have filled in our decision-table with the alternate ways of doing each phase in each sub-system. That is, we have set down other materials which might be included in the center's scope, other sources for materials, other ways in which materials might be stored, other styles of cataloging and ordering, other shipping procedures, other techniques for displaying to the learner, returning and in-processing the materials.

Suppose our chart of alternates had been made 60 years ago. We would have had to list the horse and buggy, U.S. Mail and customer pickup as the only practical ways of delivering films . . .presuming films existed in that day. If we made our chart of alternates 60 years in the future we might have additional practical ways of delivering materials. Maybe the laser will be the next addition to the list of ways one might deliver materials.

But, we made our chart, today. There is great significance in this chart of alternates. One can create a new logistical pattern from these alternates. It can be a pattern which eliminates many of the problems inherent in our current systems of materials distribution.

TABLE B AN ANALYSIS OF CURRENT PRACTICES EMPLOYED IN MATERIALS DISTRIBUTION FOR ONE CLASSROOM
PART I OUTSIDE DISTRICT

	ONE-WAY (STUDENTS PASSIVE)												
	MOTION & SOUND						STILL NON MOTION & NON AUDIO						
	16 mm	8 mm	Video Tape	Slides	Filmstrips	Transparencies	Microfilm	Stills	Drawings	Charts	Maps	Bo
SCOPE	CO AV	---	KETC	----	CO AV	---	---	---	---	---	---	---
SOURCE	Purchase	---	Rent & Local prod.	---	Purchase	---	---	---	---	---	---	---
STORAGE	Natural State	---	Natural State	---	Natural State	---	---	---	---	---	---	---
CATALOG	Books	---	Books	---	Books	---	---	---	---	---	---	---
ORDERING	People & Paper	---	Pre-sched.		---	People & Paper	---	---	---	---	---	---
PREP.SHIP.	Sack load	---	VTR load	---	Sack load	---	---	---	---	---	---	---
DELIVERY	Truck	---	Open-Circuit TV	---	Truck	---	---	---	---	---	---	---
DISPLAY	Proj. & Screen	---	RF TV Receiver	---	Proj. & Screen	---	---	---	---	---	---	---
RETURN	Trucks	---	No return	---	Truck	---	---	---	---	---	---	---
IN-PROCESS	Inspect, rewind, shelve	---	Rewind & shelve	----	Inspect, rewind, shelve		---	---	---	---	---	---

Book Pgs.

AUDIO ONLY		TWO-WAY (STUDENTS ACTIVE)						
					TACTILE DEVICES			
Audio Tape	Records	Oper. Equip.	Trainers	Programed Machine	Models	Realia	Kits	Displays
CO AV/KSLH	CO AV	---	---	---	---	---	---	---
Purchased/ Local rent	Purchased	---	---	---	---	---	---	---
Natural state/ Natural state	Aud iotape	---	---	---	---	---	---	---
Book/Mimeo guides	Book	---	---	---	---	---	---	---
People & Paper/ Pre-scheduled	People & Paper	---	---	---	---	---	---	---
Dupe/ Aud, Rec. Load	Duplicate	---	---	---	---	---	---	---
Truck/FM radio	Truck	---	---	---	---	---	---	---
Spkrs. headset/ FM receivers	Speakers Headset	---	---	---	---	---	---	---
No return/ no return	No return	---	---	---	---	---	---	---
Rewind/ rewind, shelve	Shelve	---	---	---	---	---	---	---

TABLE B AN ANALYSIS OF CURRENT PRACTICES EMPLOYED IN MATERIALS DISTRIBUTION FOR ONE CLASSROOM
PART II AFFTON DISTRICT (One of 28 districts in County)

ONE-WAY (STUDENTS PASSIVE)

	MOTION & SOUND			STILL NON MOTION & NON AUDIO								
	16 mm	8 mm	Video Tape	Slides	Filmstrips	Transparencies	Microfilm	Stills	Drawings	Charts	Maps	
SCOPE	---	---	---	---	Curric, Supv.	---	---	---	---	---	---	---
SOURCE	---	---	---	---	Purchase	---	---	---	---	---	---	---
STORAGE	---	---	---	---	Natural State	---	---	---	---	---	---	---
CATALOG	---	---	---	---	Mimeo list	---	---	---	---	---	---	---
ORDERING	---	---	---	---	People & Pager	---	---	---	---	---	---	---
PREP.SHIP.	---	---	---	---	Boxed	---	---	---	---	---	---	---
DELIVERY	---	---	---	---	District Trucks	---	---	---	---	---	---	---
DISPLAY	---	---	---	---	Proj. & Screen	---	---	---	---	---	---	---
RETURN	---	---	---	---	Truck	---	---	---	---	---	---	---
IN-PROCESS	---	---	---	---	Shelve	---	---	---	---	---	---	---

								TWO-WAY (STUDENTS ACTIVE)		
		AUDIO ONLY						TACTILE DEVICES		
Maps	Book pages	Audio Tape	Records	Oper. Equip.	Trainers	Programed Machine	Models	Realia	Kits	Displays
	---	--- ---	---	---	---	---	---	---	---	---
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TABLE B AN ANALYSIS OF CURRENT PRACTICES EMPLOYED IN MATERIALS DISTRIBUTION FOR ONE CLASSROOM
PART III AFFTON JUNIOR HIGH SCHOOL (of 251 schools in County)

ONE-WAY (STUDENTS PASSIVE)

	MOTION & SOUND			STILL NON MOTION & NON AUDIO								
	16mm	8 mm	Video Tape	Slides	Filmstrips	Transparencies	Microfilm	Stills	Drawings	Charts	Maps	
SCOPE	---	---	---	Dept. Involved	Dept. Involved	Dept. Involved	---	Dept. Involved	Dept. Involved	Dept. Involved	Dept. Involved	Li
SOURCE	CO AV	---	KETC	Purchased Local Prod.	Purchased	Purchased Local Prod.	---	Purchased Local Prod.	Purchased Local Prod.	Purchased Local Prod.	Purchased	Pu
STORAGE	Natural State	---	---	Natural State	Natural State	Natural State	---	Natural State	Natural State	Natural State	Natural State	N St
CATALOG	Delivery Receipt	---	---	---	---	---	---	---	---	---	---	Co Co
ORDERING	Self service	---	Pre-sched.	Self service	Self service	Self service	---	Self service	Self service	Self service	Self service	Se
PREP. SHIP.	---	---	---	---	---	---	---	---	---	---	---	--
DELIVERY	Pickup	---	Antenna	Pickup	Pickup	Pickup	---	Pickup	Pickup	Pickup	Pickup	Pi
DISPLAY	Proj. & Screen	---	RF Reciever	Proj. & Screen	Proj. & Screen	Proj. & Screen	---	Dirert & Proj.	Direct & Proj.	Direct	Direct	Di
RETURN	Hand carry	---	No return	Hand carry	Hand carry	Hand carry	---	Hand carry	Hand carry	Hand carry	Hand carry	Re Ha Ch
IN-PROCESS	---	---	---	Shelve	Shelve	Shelve	---	Shelve	Shelve	Shelve	Shelve	She

ps	Book pages
d	Library
ed	Purchased
	Natural State
	Card Catalog
vice	Self service

	Pickup
	Direct or Read aloud
arry	Hand carry
	Check-in Shelve, Ins.

AUDIO ONLY		TWO-WAY (STUDENTS ACTIVE)						
					TACTILE DEVICES			
Audio Tape	Records	Oper. Equip.	Trainers	Programed Machine	Models	Realia	Kits	Display
--- ---	Dept. Involved	Dept. Involved	Dept. involved	---	Dept. Involved	Dept. Involved	Dept. Involved	---
--- ---	Purchased	Purchased	Purch.	---	Purchased	Local accm.	Purchased	---
--- ---	Natural State	Natural State	Natural State	---	Natural State	Natural State	Natural State	---
--- ---	---	---	---	---	---	---	---	---
--- ---	Self Service	Self service	Self Service	---	Self service	Self service	Self service	---
--- ---	---	---	---	---	---	---	---	---
--- ---	Pickup	Pickup	Pickup	---	Pickup	Pickup	Pickup	---
--- ---	Speakers & Headphones	Direct	Direct	---	Direct	Direct	Direct	---
--- ---	Hand carry	Hand carry	Hand carry	---	Hand carry	Hand carry	Hand carry	---
--- ---	Shelve	Shelve	Shelve	---	Shelve	Shelve	Shelve	---

TABLE B AN ANALYSIS OF CURRENT PRACTICES EMPLOYED IN MATERIALS DISTRIBUTION FOR ONE CLASSROOM

Part IV SEVENTH GRADE SOCIAL STUDIES CLASSROOM (One of 6,744 in County)

ONE-WAY (STUDENTS PASSIVE)

	MOTION & SOUND				STILL NON MOTION & NON AUDIO							
	16 mm	8 mm	Video Tape	Slides	Filmstrips	Transparencies	Microfilm	Stills	Drawings	Charts	Maps	
SCOPE	---	---	---	---	---	---	---	Teacher File	Teacher File	Wall hung	Wall hung	Wa
SOURCE	CO AV	---	KETC	---	CO AV	---	---	Magazines	Local Production	Purchased	Purchased	Pur
STORAGE	Natural State	---	---	---	Natural State	---	---	Natural State	Natural State	Natural State	Natural State	Na Sta
CATALOG	Requisition Duplicate	---	Teacher Manual	---	Requisition Duplicate	---	---	---	---	---	---	---
ORDERING	Self service	---	Pre-sched.	---	Self service	---	---	Self service	Self service	Self service	Self service	Sel
PREP.SHIP.	---	---	---	---	---	---	---	---	---	---	---	---
DELIVERY	Pickup	---	Antenna Connection	---	Pickup	---	---	Pickup	Pickup	Not Moved	Not Moved	Pic
DISPLAY	Proj. & Screen	---	RF Receiver	---	Proj. & Screen	---	---	Direct & Proj.	Direct & Proj.	Direct	Direct	Dir
RETURN	Hand carry	---	No return	---	Hand carry	---	---	Hand carry	Hand carry	---	---	Har
IN-PROCESS	---	---	---	---	---	---	---	File	File	---	Roll up	Ch

							TWO-WAY TUDENTS ACTIVE)			
		AUDIO ONLY					TACTILE DEVICES			
Maps	Book Pages	Audio Tape	Records	Oper. Equip.	Trainers	Programed Machine	Models	Realia	Kits	Displays
hung	Wall hung	Shelf ---	---	---	---	---	Shelf (Globe)	Shelf & Bull Bd.	---	Shelf & Bull. Bd.
sed	Purchased	Local Prod./---	---	---	---	---	Purchased	Collected	---	Local Production
al	Natural State	Natural state/---	---	---	---	---	Natural State	Natural State	---	Natural State
	---	--- ---	---	---	---	---	---	---	---	---
rvice	Self service	Self Service/---	---	---	---	---	Not moved	Not moved	---	Not moved
	---	--- ---	---	---	---	---	---	---	---	---
	Pickup	Pickup/---	---	---	---	---	---	---	---	---
	Direct	Speakers Headphones/ ---	---	---	---	---	Direct	Direct	---	Direct
	Hand carry	Hand carry/ ---	---	---	---	---	---	---	---	---
	Check in	Rewind Shelve/---	---	---	---	---	---	---	---	---

TABLE "B"

DECISIONS - TABLE FOR MATERIALS SYSTEM DEVELOPMENT, EVALUATION OR MODIFICATION

	SCOPE	SOURCES	STORAGE	CATALOGING
MOTION AND SOUND SUB-SYSTEM	*Motion pictures *Videotape recordings *Kinescopes (TV-made films)	*Purchase or rental source of films or videotapes Local open circuit TV (off-the-air recordings) *Local Television production facilities Local Film Production facilities	*Natural State Converted to 16 mm film Converted to 8 mm film Converted to videotape	Card Catalog *Book form catalog Computer memory bank information The shelving labels
STILL PICTURE SUB-SYSTEM	Filmstrip Book pages Charts Slides Photos Drawings Maps Programs	*Purchase from the publishers of stills *Local photo production facilities *Local printing facilities *Local graphic arts production facilities	*Natural state Converted to disc videotape Converted to slides Converted to microfilm Converted to paper print	Card catalog *Book form catalog Computer memory bank information The shelving labels
AUDIO SUB-SYSTEM	Audio (U) *Phonograph records *Magnetic tape recordings	*Local portable taperecorders Local recording studio facilities *Purchase from producers of phonographs & pre-recorded audio tapes AM & FM radio (off-the-air recordings)	*Natural state Converted to magnetic tape (reel to reel) Converted to magnetic tape (cartridge)	*Book form catalog Card catalog Computer banked info The shelving labels

* Indicates being employed via three currently existing sub-systems

1. Audio-Visual Department of Cooperating Scho

	ORDERING	PREPARATION FOR SHIPMENT	DELIVERY
NG g atalog mory banked on g labels	*People & paper work (totally manual) People & low order data processing machines People, machines & computer People, dataphone, machines & computer (highly automated) *Pre-scheduled (no ordering)	*materials packaged for shipment (sack, box, etc.) *Projector-TV film chain loading *Videotape recorder loading	United States mail *Delivery trucks *Customer pickup *open circuit television Bell cabled television Pulse modulated cable television 2500 megacycle television Point to point microwave television
g catalog mory banked on g labels	*People & paper work (totally manual) People & low order data processing machines People, machines and computer People, dataphone, machines and computer (highly automated) Pre-scheduled (no ordering)	*materials packaged for shipment (sack, box, etc.) Projector-TV film chain loading Videot recorder loading	United States mail *Delivery trucks Slow scan bell cabled TV Bell cabled television Pulse modulated cabled TV 2500 megacycle television Point to point microwave TV Open circuit television Wirephoto, dataphone
catalog g nked information g labels	*People & paper work (totally manual) People & low order data processing machines People, machines & computers People, dataphone, machines & computers (highly automated) *Pre-scheduled no ordering	*Materials packaged for shipment (sack, box, etc.) Audio recorder loading	AM radio, *FM radio multiplexed FM radio Telephone, *delivery trucks United States mail, *Customer pickup Audio portion of television

ting School System

2. KETC Educational Television (Channel 9)

3. KSLH Educational Radio (St. Louis Public Schools)

	DISPLAY TO LEARNER	RETURN TC DEPOSITORY	IN-PROCESSING
ll evision vision cable television elevision icrowave television	*Projection on individual or group screen *Television screen	*Truck return to central storage *Non-return (erase or dispose of locally, or locally save) *Customer return	*inspect, repair, rewind, shelve *Rewinds, shelve
ll bled TV vision cabled TV elevision icrowave TV evision one	Direct viewing of opaque materials *Projection on individual group screen Television screen Microfilm reader Slide viewer	*Truck return to central storage Non-return (erase or dispose of locally, or locally save) *Customer return	*Inspect, repair, rewind, shelve Rewind, shelve
lo radio ery trucks l, *Customer television	*Loudspeakers *Headphones	Truck return to central storage *Non-return (dispose of locally, or locally save) *Customer return	*Inspect, repair, rewind, shelve *Rewind , shelve

ic Schools)